AERONAUTICAL ENGINEERING REVIEW

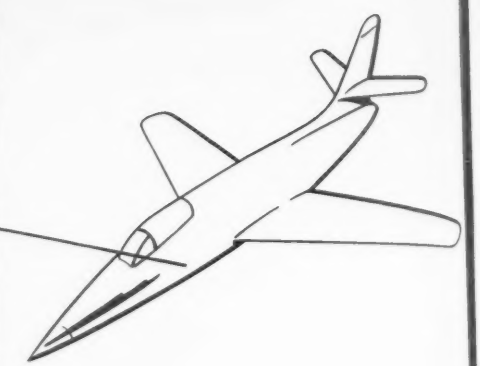
DECEMBER 1951

THIRD ANGLO-AMERICAN AERONAUTICAL CONFERENCE

SAVING WEIGHT

where it counts

most today



Resistoflex hose assemblies using integral
FORGED ALUMINUM elbow fittings eliminate needless adapters

Every pound saved means that much more fuel or load capacity. That's one reason for using Resistoflex straight and elbow hose fittings in today's power-packed airplanes. They eliminate the extra weight of adapter fittings. *Fewer parts also mean less risk of leakage.*

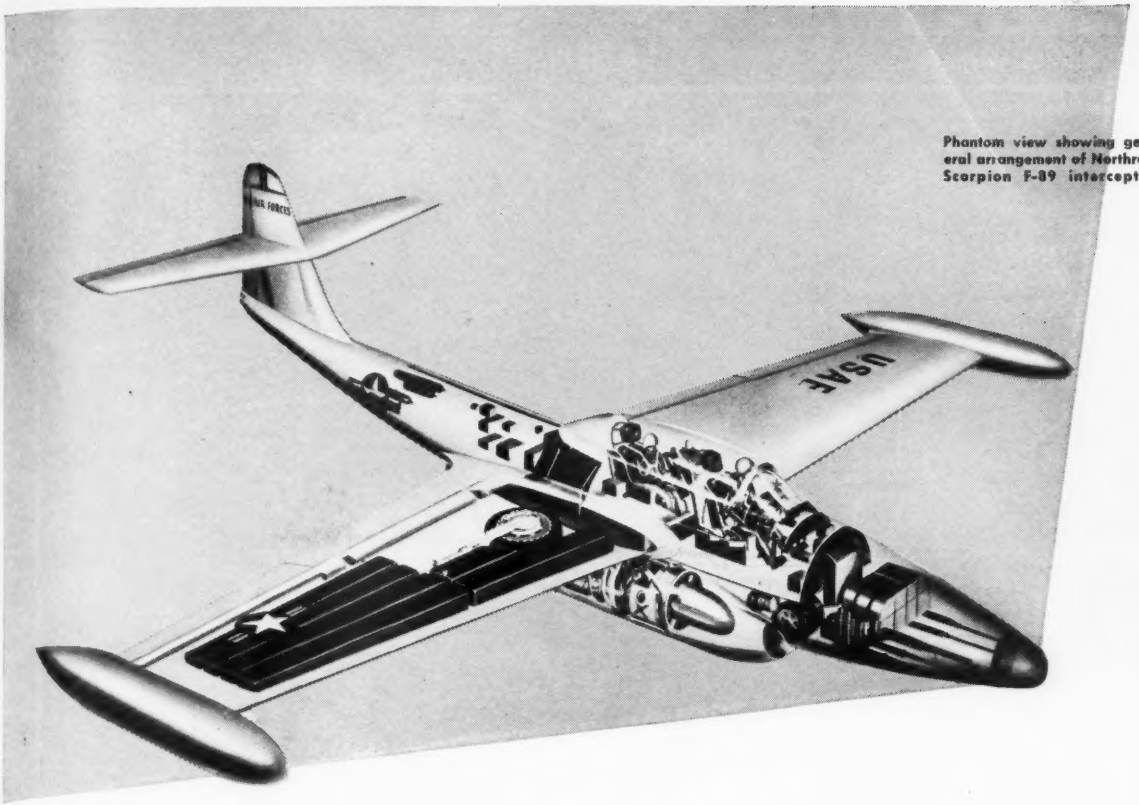
But that's not all. Resistoflex fittings are *compact*. Our elbows especially need less space. Machined with true internal bends, they also deliver full flow with minimum turbulence.

Do you have the specifications and flow test data on these rugged, service-proved assemblies? If not, write for your copy of the Resistoflex Aircraft Catalog.

RESISTOFLEX
CORPORATION
Belleville 9, New Jersey

TEFLON, KEL-F
for high performance

Fluorocarbon resins processed on exclusive Resistoflex-designed equipment under trade mark FLUOROFLEX® provide *optimum* physical and electrical properties combined with *uniformity* in rod, sheet, "O" rings, "back-washers," "spaghetti" and other finished parts.



Phantom view showing general arrangement of Northrop Scorpion F-89 interceptor

Secret of the Scorpion's Range!

Bullet-sealing fuel tanks and PLIOCEL wing tanks—both by Goodyear—give extra-long range to the Scorpion, the U.S.A.F.'s newest all-weather interceptor.

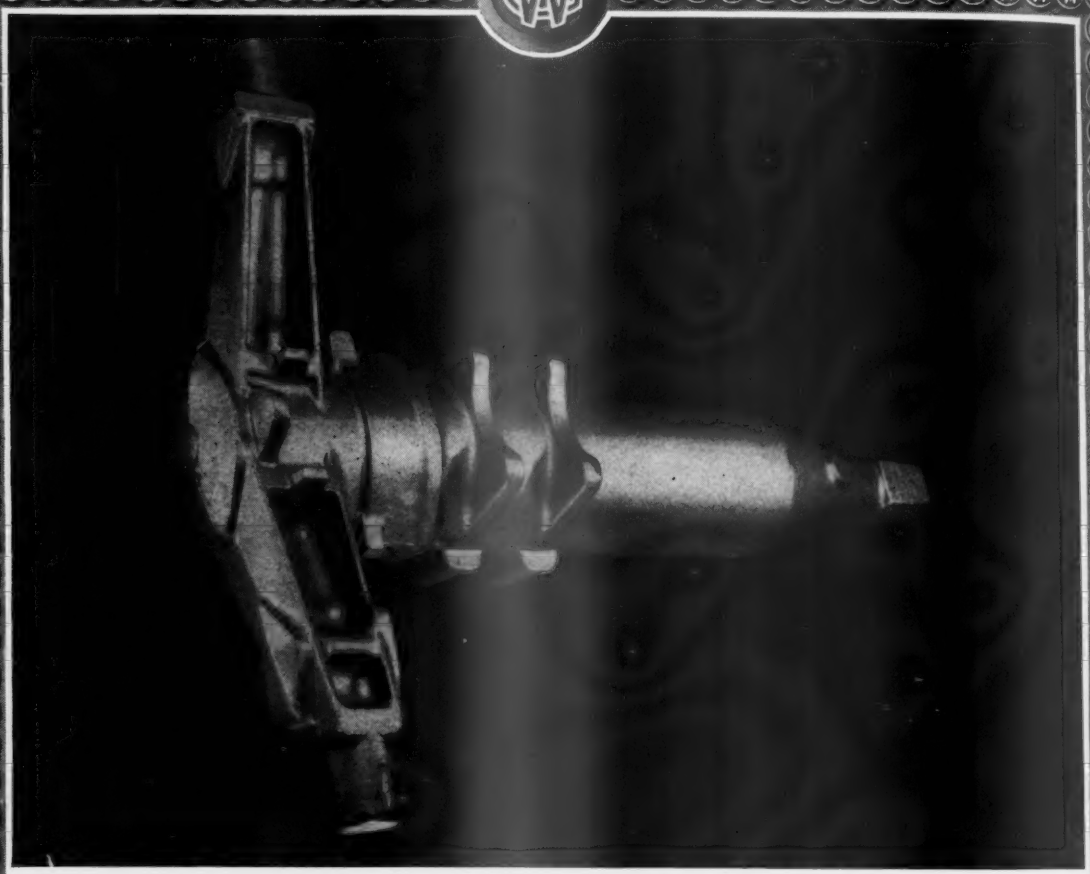
Because of the extremely thin wing section of this twin-jet aircraft, twelve bantam-weight PLIOCEL tanks made by Goodyear are used to take advantage of every available nook and cranny—providing maximum fuel capacity with minimum weight. Folding easily for installation in small apertures, these specially-treated bladder cells of gas-tight nylon fabric actually outlast heavier metal containers!

Four lightweight bullet-sealing tanks in the fuselage complete this new 16-tank, 100%-Goodyear fuel tank system—a typical example of practical Goodyear service to aviation. For full information on these and other Goodyear aviation products, write: Goodyear, Aviation Products Division, Akron 16, Ohio or Los Angeles 54, California.

GOODYEAR
AVIATION
PRODUCTS

Pliocel—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

MORE AIRCRAFT LAND ON GOODYEAR TIRES, TUBES, WHEELS AND BRAKES THAN ON ANY OTHER KIND



Forgings for the aircraft industry today demand the utmost in engineering and production techniques and in scientific laboratory control. This massive complicated landing gear component, weighing over 400 pounds, is typical of Wyman-Gordon's forging contribution to the ever-growing progress in aircraft design. In crankshafts for the automotive industry and in all types of aircraft forgings, steel and light alloy, Wyman-Gordon has pioneered in the development of forging "know-how"—there is no substitute for Wyman-Gordon experience.

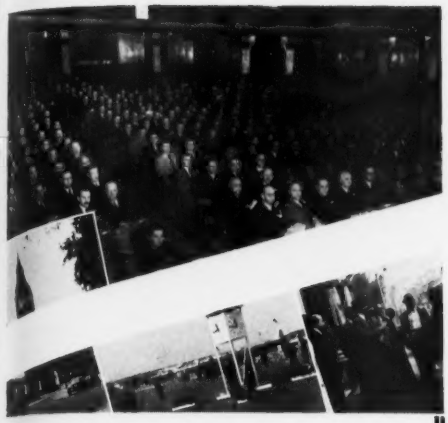
Standard of the Industry for More Than Sixty Years

WYMAN-GORDON

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL

WORCESTER, MASSACHUSETTS

HARVEY, ILLINOIS DETROIT, MICHIGAN



Cover—Opening session at the Third Anglo-American Aeronautical Conference, Brighton, England, September 4, 1951. (See article, page 24.)

Editor
Welman A. Shrader

Managing Editor
Berneice H. Jarck

Assistant Editor
John J. Glennon

Book Reviews Editor
Maurice H. Smith

News Editor
Beverly A. Dodge

Editorial Assistant
Marylu Howell

Technical Advisers
Hugh L. Dryden
Robert R. Dexter
S. Paul Johnston

Business Manager
Joseph P. Ryan

Western Office
7660 Beverly Blvd., Los Angeles 36, Calif.

ABC

SUBSCRIPTION RATES

Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies, $0.50. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.50.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pa.

Editorial Office: 2 East 64th Street, New York 21, N.Y. Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute.

Copyright, 1951, by the Institute of the Aeronautical Sciences, Inc.

AERONAUTICAL ENGINEERING REVIEW

Vol. 10 DECEMBER, 1951 No. 12

Contents

I.A.S. News 19
Guest Editorial 22, 23

Articles

Impressions of the Third Anglo-American Aeronautical Conference . . . . Welman A. Shrader 24
Aerodynamic Aspects of the Third International Aeronautical Conference . . . . . A. H. Flax 35
Review of Papers on Air Transport . . . . . R. W. Rummel 40
A Review of Papers on Structures and Materials . . . . . Nicholas J. Hoff 42
Some Observations on Aeronautical Research in England with Particular Reference to Stability and Control . . . . . William F. Milliken, Jr. 45
Comparisons of British and American Gas-Turbine Practice . . . . E. S. Thompson and N. Burgess 47
Hydrodynamic Notes on the Third International Aeronautical Conference . . Ernest G. Stout 49
I.A.S. Previews 53

Reviews

Aeronautical Reviews 85
Books 115

Personnel Opportunities 131
Index to Volume 10 137
Index to Advertisers 142, 143

Published Monthly by the Institute of the Aeronautical Sciences, Inc.

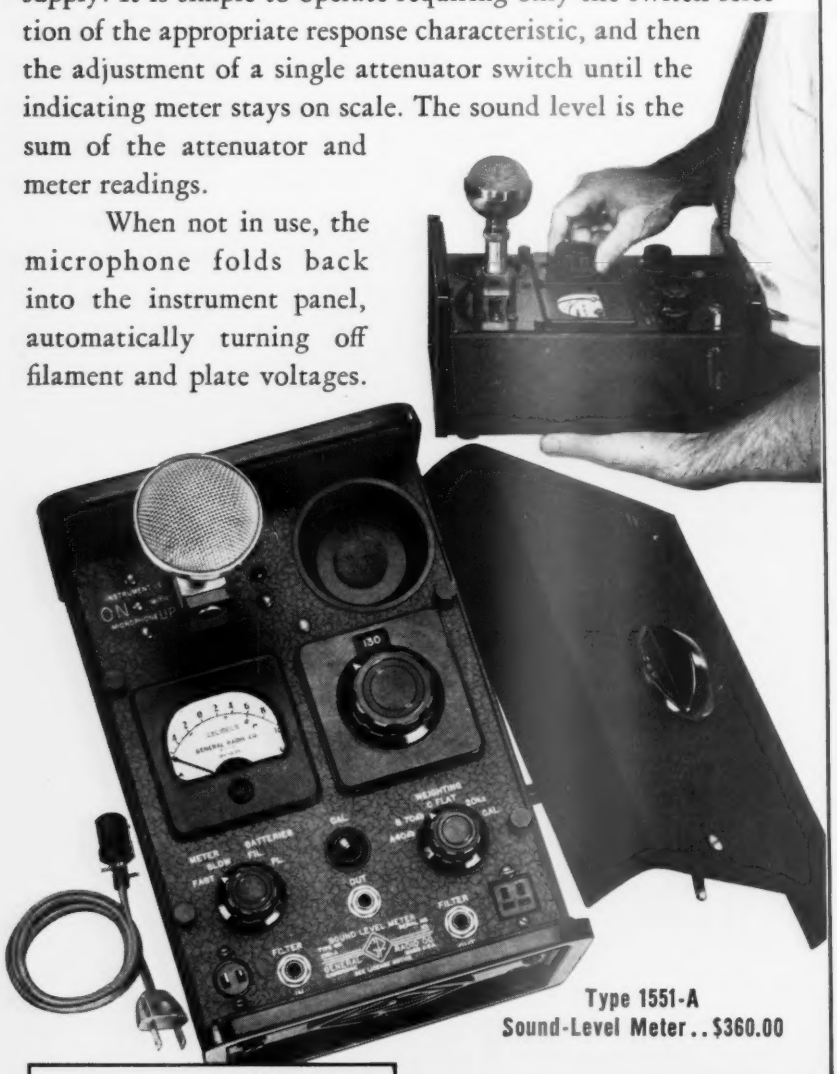
NEW SOUND LEVEL METER

Improved Design

Accurate · Simple to Use

The new Type 1551-A Sound-Level Meter is very easy to handle. It weighs only 11 pounds, including its battery power supply. It is simple to operate requiring only the switch selection of the appropriate response characteristic, and then the adjustment of a single attenuator switch until the indicating meter stays on scale. The sound level is the sum of the attenuator and meter readings.

When not in use, the microphone folds back into the instrument panel, automatically turning off filament and plate voltages.



Type 1551-A Sound-Level Meter . . $360.00

MEETS ALL STANDARDS *of the American Standards Association, the A. I. E. E. and the Acoustical Society of America*

PORTABLE — *weighs only 11 pounds, with batteries*

SIMPLE TO OPERATE — *non-technical personnel can make just as accurate measurements as can anyone*

COMPLETE BATTERY OPERATION *from standard batteries, readily available*

VERY WIDE RANGE *of 24 to 140 db; will measure practically any noise level found in industry*

EXCELLENT STABILITY — *improved negative feedback amplifier circuits*

NON-DIRECTIONAL CRYSTAL-DIAPHRAGM MICROPHONE

TWO-SPEED INDICATING METER *for steady or rapidly fluctuating sounds*

EXCELLENT ACCURACY — *frequency response curves within current A.S.A.-specified tolerances; when amplifier sensitivity is standardized absolute accuracy of measurement is within ±1 db for average machinery noises*

INTERNAL CALIBRATING CIRCUIT — *sensitivity can be standardized at any time from any 115-volt a-c line*

WIDE FREQUENCY RESPONSE *of amplifier and panel meter — 20 cycles to 20 kilocycles*

LOW TEMPERATURE & HUMIDITY EFFECTS — *readings independent of both over normal room conditions (within 1 db)*

READILY USED WITH ACCESSORY INSTRUMENTS *such as graphic-level recorders, frequency and wave analyzers, magnetic-tape recorders*

MANY ACCESSORIES AVAILABLE *for special applications; included are special microphones for high fidelity measurements, for reproducible standards and for use at end of long cable.*

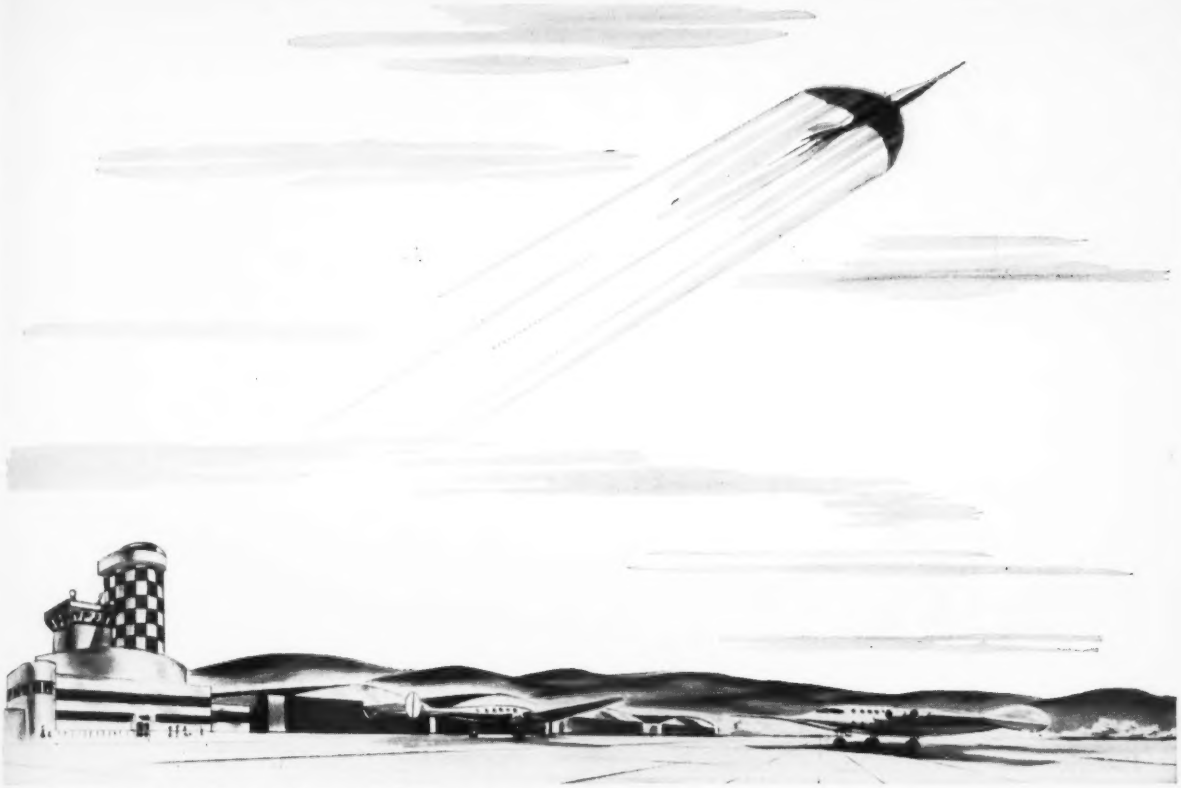
STROBOSCOPES • VARIACS • SOUND-LEVEL METERS
VIBRATION METERS • IMPEDANCE BRIDGES
SIGNAL GENERATORS • OSCILLATORS
WAVE ANALYZERS • DISTORTION METERS
IMPEDANCE STANDARDS • VACUUM-TUBE
VOLTMETERS • FREQUENCY STANDARDS
BROADCAST MONITORS • PARTS AND ACCESSORIES

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

90 West Street NEW YORK 6 — 920 S. Michigan Ave. CHICAGO 5 — 1000 N. Seward St. LOS ANGELES 38

Since 1915—Designers and Manufacturers of Electronic Test Equipment



from sea level to substratosphere . . .

VARGLAS SILICONE

Electrical Insulating Tubing and Sleeving

WITHSTANDS TEMPERATURES FROM 500° TO —85°F

VARGLAS SILICONE is a high dielectric, dimensionally stable insulating material developed by Varflex during World War II to assure dependable performance in the drastic temperatures aircraft might encounter from sea level to substratosphere. Today, Varglas Silicone serves industry in many of the tough insulating jobs that defeat ordinary insulators. A combination of *Varglas* (continuous filament Fiberglas) and *Silicone High Temperature* Resin, Varglas Silicone is the first and only Class H insulation with these features:

EFFICIENT AT 500°F. — flexible at —85°F.

MOISTURE AND FUNGUS-RESISTANT — has excellent resistance to moisture and fungus.

FIRE-RESISTANT — flame resistant and self-extinguishing.

ABRASION-RESISTANT — pliable and non-fraying.

DIELECTRICALLY STRONG — average readings up to 7,000 volts.

Available in various NEMA colors in several types and grades of tubing and sleeving — lead wire and tying cord, too.

Varflex CORPORATION

Makers of Electrical Insulating Tubing and Sleeving

VARFLEX *Sales Co., Inc.*

311 N. Jay St., Rome, N. Y.

Take a bow, fellers!

Precision and quality don't grow on trees. But they grow.

At Keuffel & Esser precision and quality are almost a century plant. In other words they have been growing there in fertile soil for exactly 84 years. (K&E was founded in 1867.)

It's mostly a matter of people. Oh, there are machines, too, big ones, little ones—some of them almost human—but it takes people to imagine the machines, and to master them and supplement them.

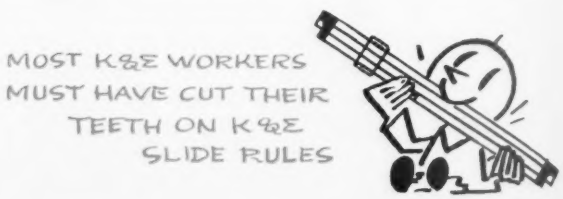
Precision in the Air

I've been talking about K&E products for a long, long time. Maybe it's time I talked a little about the people behind them.

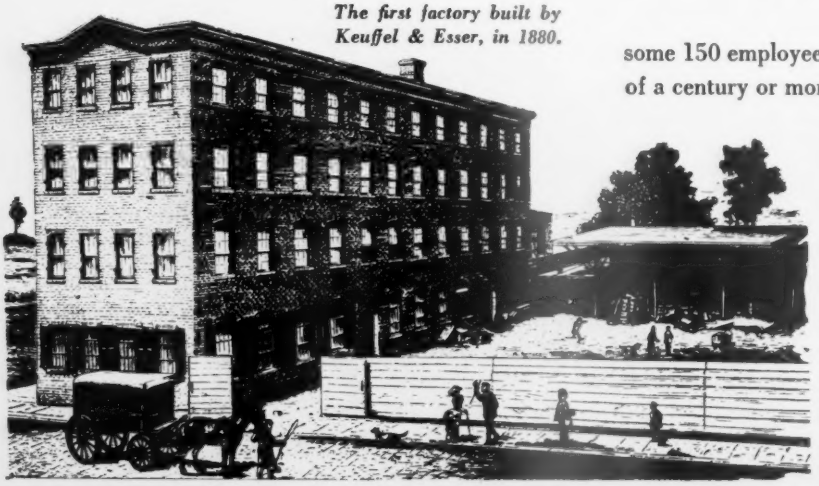
I've just been through the K&E factory at Hoboken again. I wish you could have been along, because you, as an engineer, would have seen much more than I. But even I could sense the honest craftsmanship and the father-and-son tradition of precision and the zeal for quality in the air.

You just don't get to be that fine in one generation.

There are a number of K&E employees who have been around for about a half a century, and there are some 150 employees who have been there for a quarter of a century or more. This latter bunch of kids, as well as the young sprouts who have been there only 20 or 15 years, have inherited the K&E feeling for doing things the good, old, exciting, honest way.



But don't get the idea that there is any moss on K&E. An outfit that has thrived this long has to have the knack of remaining perennially young and of keeping ahead of the pack.



The first factory built by Keuffel & Esser, in 1880.

"Partners in Creating"

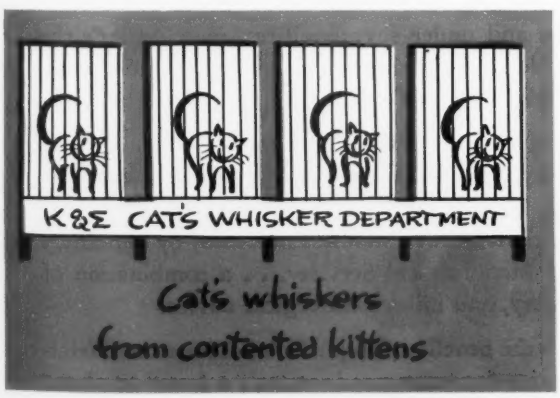
When K&E coined the phrase "Partners in Creating," they of course meant not themselves but their products. And it's true that K&E products have been in with engineers, scientists, draftsmen and architects on the

The K&E trade mark for decades, and the more modern one adopted in recent years.

creation of most of the big man-built wonders of the world for over 4/5 of a century.

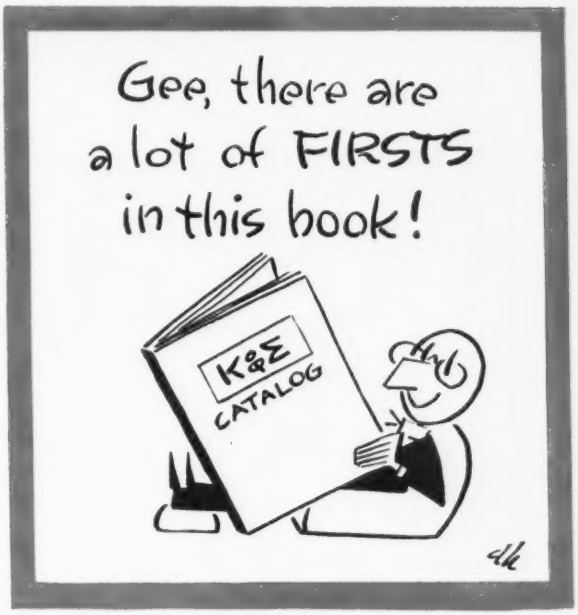
Zippy at 84

K&E have remained alert and alive, as is evidenced by their unending originality and inventiveness. They made America's first slide rules, as far back as 1891. And in both world wars, they did a big development job on optical equipment for our fighting men—on vital things such as periscopes, fire control instruments and height finders. The K&E catalog is full of "firsts"—some of them plenty recent, such as Wyteface* Measuring Tapes and Leroy† Lettering Equipment. No wonder it's the engineers' encyclopedia.



Factories within a Factory

K&E headquarters are a town within a town, many factories within a factory. In one area they're coating miles of papers and cloths. In another they're turning screws so tiny you feel like a hippopotamus if you try to pick one up. Here they're grinding optical lenses.



There they're putting graduations no bigger than a fly's kneecap on scales of some sort. Here they're doing fastidiously fine leather work. There they're reeling off steel measuring tapes by the mile.

K&E was in there sighting, in World Wars I and II

But wherever you go you are aware of the age-old passion for precision and quality. And I'm not the least bit sorry that today I haven't sold you a single K&E product. I've just tried a little bit to sell you on the people at K&E—and to get you to believe that you can safely make K&E products trusted partners in your own creative work.

*Trade Mark
†Trade Mark ®

K+E
partners in creating
For 84 years K&E equipment and materials have been partners of the draftsman, engineer and scientist in shaping the modern world.

KEUFFEL & ESSER CO.
EST. 1867
Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules, Measuring Tapes
NEW YORK • HOBOKEN, N. J.
CHICAGO • ST. LOUIS • DETROIT • SAN FRANCISCO
LOS ANGELES • MONTREAL

They're saying *Mighty Fine Things* about ELECTRUNITE TUBING at Ryan...

Steps in production of Ryan-patented Ball-and-socket-joint Exhaust Assembly, fabricated from ELECTRUNITE *Stainless Steel Tubing by Ryan Aeronautical Company for the Douglas C-124 "Globemaster II."*

"...lends itself very well to achieving unusual configurations..."

•

"...production is conducted with high degree of efficiency and low factor of waste..."

•

*"...*ELECTRUNITE'S *uniform wall thickness allows sure, safe, controllable bending of the tube without wrinkling..."*

•

"...uniform in diameter, strength, weight, workability and other characteristics..."

Expanded on a punch press, swaged, bent to shape . . . then subjected to hundreds of service hours at cherry-red exhaust temperatures and under severe vibration . . . that's the punishment dealt out to these stainless steel exhaust stacks on the Douglas C-124 "Globemaster II."

High physical and metallurgical accuracy are two of many advantages Ryan gained by specifying Republic ELECTRUNITE Tubing. Ryan metallurgists were assisted in their choice of the right ENDURO stainless steel alloy by Republic's 3-Dimension Metallurgical Service . . . a combination of field, laboratory, and mill metallurgical advice.

You can have the benefits of Republic's 3-Dimension Metallurgical Service for your products . . . a letter or phone call will bring the Republic Field Metallurgist to you.

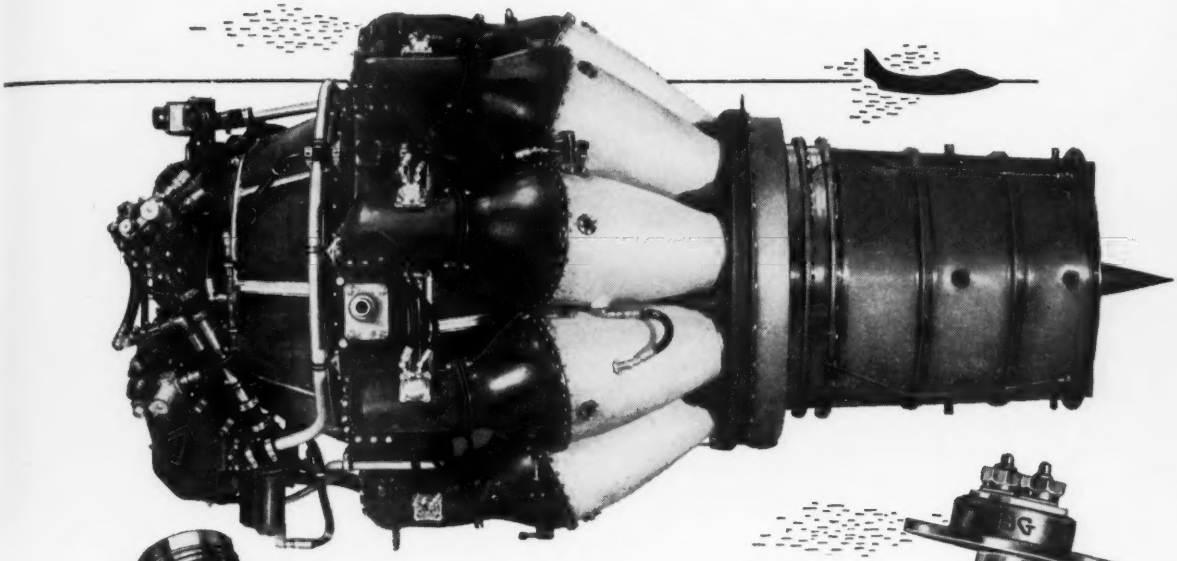
REPUBLIC STEEL CORPORATION
STEEL & TUBES DIVISION
224 EAST 131st STREET • CLEVELAND 8, OHIO

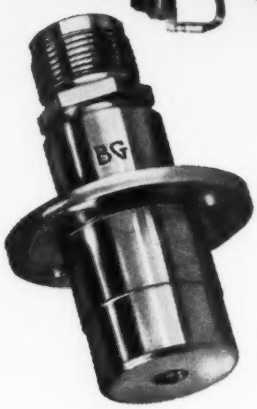
REPUBLIC STEEL

Republic ELECTRUNITE®
STAINLESS STEEL TUBING AND PIPE

THE PRATT & WHITNEY J-42 JET ENGINE

approved for 1000-hour overhaul...



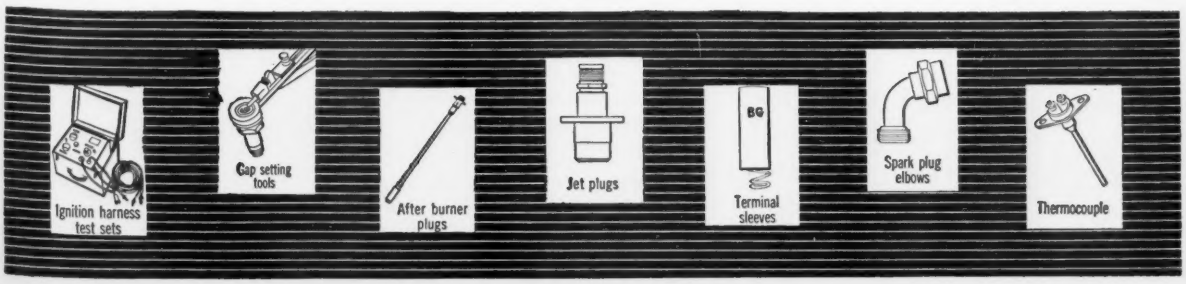


The B G Corporation is proud of its contribution to the success of this engine... equipped with the B G surface gap igniter and the B G thermocouple and thermocouple harness.

•

For information on this and other BG products, write:

THE BG CORPORATION
136 WEST 52nd STREET,
NEW YORK 19, N. Y.



the Skill

the Facilities

. . . That Lead the Way in COLD FORGING METHODS

Innumerable parts ordinarily produced by machining operations have been made faster, at less cost and to close tolerances by the application of cold forging methods. This has proved especially true at Allied. Here production men not only have the best of cold forging plant facilities at their disposal but also have the experience and ingenuity to determine how such facilities can be best adapted to production of special cold forged parts or standard hexagon head cap screws . . . in quantities of thousands or millions . . . at lowest possible cost to the customer.

At all of the Allied plants — in every department — is the *right* combination of skill and facilities. It's worth remembering when you are looking for a dependable source for the types of products manufactured by Allied.

Other

ALLIED PRODUCTS

HARDENED AND PRECISION GROUND PARTS • SHEET METAL DIES FROM THE LARGEST TO THE SMALLEST • ALLITE ZINC ALLOY DIES • JIGS • FIXTURES • R-B INTERCHANGEABLE PUNCHES AND DIES.

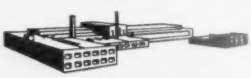
PRECISION • EXPERIENCE • DEPENDABILITY

ALLIED CORPORATION PRODUCTS

ALLIED PRODUCTS CORPORATION

DEPT. D-3 • 12655 BURT ROAD • DETROIT 23, MICH.

PLANT 1
Detroit, Mich.



PLANT 2
Detroit, Mich.

PLANT 3
Hillsdale, Mich.

PLANT 4
Hillsdale, Mich.

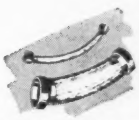
Lightweight Actuators...

with Strong-arm Power

or a Watchmaker's Skill!

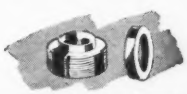
Whether you want to raise the heaviest landing gear or exercise the most precise positioning control, Breeze actuators can meet your exact requirements. A pioneer in actuator design, Breeze has the engineering experience, the production capacity and skill to solve problems quickly, to meet your delivery schedules. So whatever you want to push, pull, raise, lower, hold, release, twist or otherwise control, it pays to talk actuators with Breeze.

Aero-Seal Vibration-Proof Hose Clamps



Flexible conduit and ignition assemblies.

Multiple contact connectors to meet government specifications.



Job engineered, welded-diaphragm bellows.

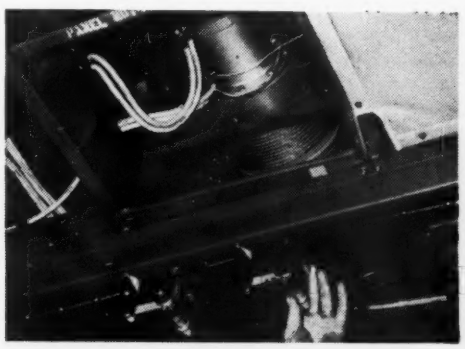
WRITE TODAY outlining your control problem; or submit your sketches. Our engineers will gladly assist you.

BREEZE

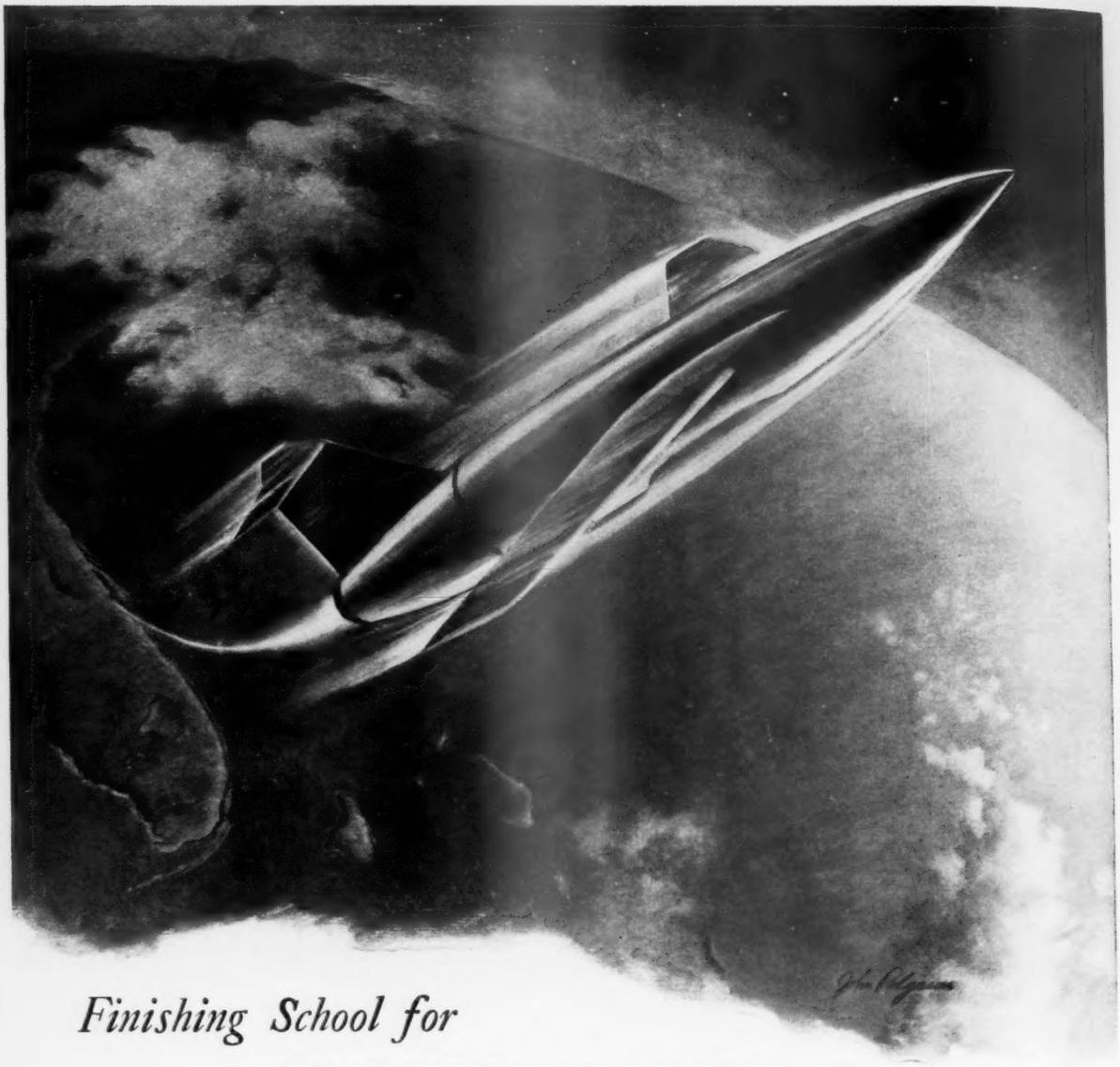
Electrical and Hydraulic
ACTUATORS & CONTROLS

BREEZE CORPORATIONS, INC.

41 South Sixth Street Newark, New Jersey



Breeze rotary actuator releases twenty 500 lb. paratainers from Fairchild Packet in 10 seconds.



Finishing School for

GUIDED MISSILES

The Air Force Missile Test Center, used by all our military services as a long-range proving ground, stretches thousands of miles from Florida, out over the Bahamas, into the South Atlantic.

A pilotless bomber roars away from its launching stand, picks up speed, zooms into the blue. Setting its course for a far-off target in the ocean, it rockets over a chain of tiny islands where men and machines check its flight, its behavior, the operation of its guidance and control systems. It's a vital part of our air power of the future—aeronautical research and development laying the foundation for continued U. S. air supremacy!

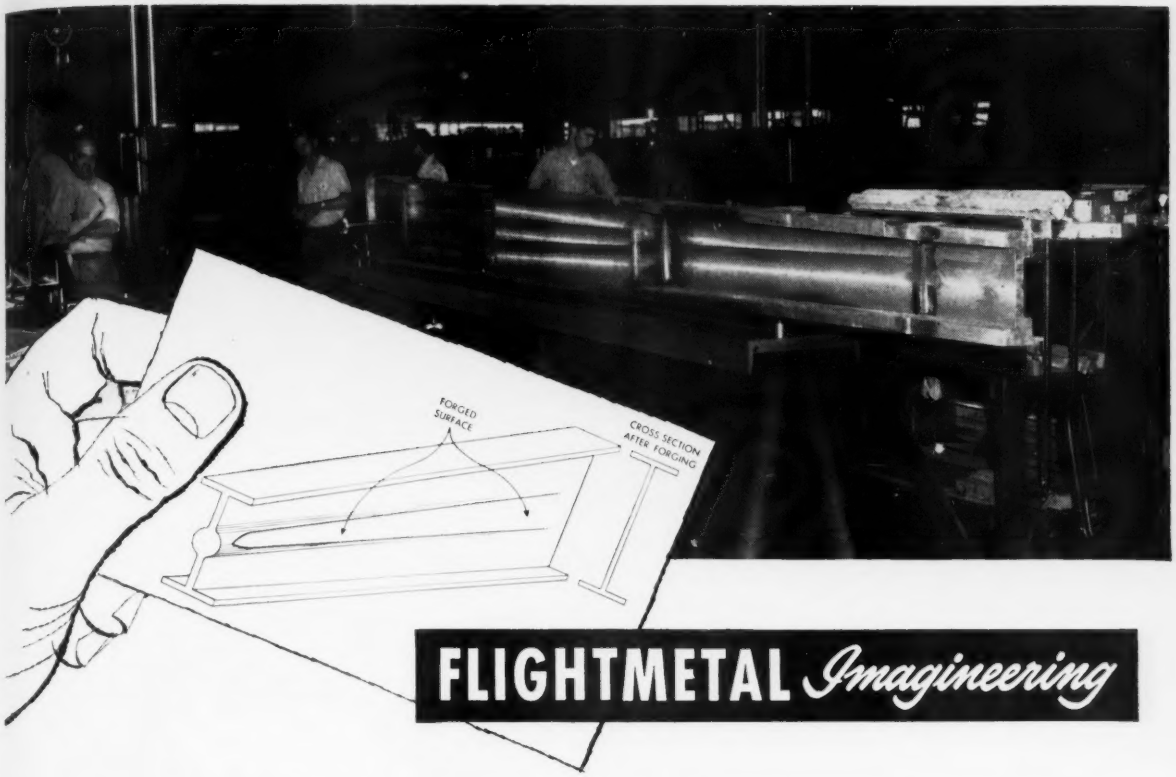
Operated by the USAF's Air Research and Development Command, the Missile Test Center is geared up to test the wide variety of missiles, rockets and pilotless aircraft vital to modern air power. It reached its full stature with the recent completion of down-range observation stations. And the dramatic B-61 pilotless bomber, the Matador, designed and produced by Martin as part of its diversified missiles program, was the first to use the completed range. THE GLENN L. MARTIN COMPANY, Baltimore 3, Maryland.

Martin AIRCRAFT

Builders of Dependable Aircraft Since 1909

Illustration is artist's conception of Air Force B-61 Matador pilotless bomber.

DEVELOPERS AND MANUFACTURERS OF: Navy P5M-1 Marlin seaplanes • Air Force B-57A Canberra night intruder bombers • Air Force B-61 Matador pilotless bombers • Navy P4M-1 Mercator patrol planes • Navy KDM-1 Plover target drones • Navy Viking high-altitude research rockets • Air Force XB-51 developmental tactical bomber • Martin airliners • Guided missiles • Electronic fire control & radar systems • **LEADERS IN** Building Air Power to Guard the Peace, Air Transport to Serve It.



FLIGHTMETAL *Imagineering*

forge-tapers a one-piece wing spar

Ordinarily, a tapered aluminum wing spar is made with two long machine-tapered, T-shaped extrusions. Takes about 50 major parts, a lot of rivets, many separate operations.

At McDonnell Aircraft, a production executive wondered...why not make a one-piece spar from an I-beam extrusion tapered by the forging process? He talked it over with Alcoa engineers ... and now ... McDonnell has built them into experimental aircraft.

The new spar is an Alcoa 75S-T6 Extrusion with a bulb of metal in the web. Forging flattens the bulb progressively, so that the 13-foot spar finally tapers from 15½ to 10 inches deep. Besides simplifying production, the one-piece spar is *50 pounds lighter* than the former design.

If you have a problem involving aluminum or magnesium, we'd welcome an opportunity to pool our facilities and know-how with yours in the interests of *Flightmetal Imagineering.*

ALCOA ALUMINUM MAGNESIUM

Ask ALCOA for the Flightmetal Training Aids you need

Alcoa's complete library of design and fabricating information is available now to help you train employees—add to your own know-how. Your nearby Alcoa sales office will supply books free, lend you films. Or check what you need on this coupon and mail to ALUMINUM COMPANY OF AMERICA, 1801M Gulf Building, Pittsburgh 19, Pennsylvania.

- ☐ **Forming Alcoa Aluminum.** Describes methods, alloy characteristics. 65 pages.
- ☐ **Designing for Alcoa Die Castings.** Applications, design practice, alloys, production, finishing. 188 pages.
- ☐ **Machining Alcoa Aluminum and Its Alloys.** Tools, methods, speeds, feeds. 68 pages.
- ☐ **Welding and Brazing Alcoa Aluminum.** Shop manual on all techniques. 137 pages.
- ☐ **Alcoa Aluminum and Its Alloys.** Properties, tolerances, sizes. 178 pages.
- ☐ **Designing for Alcoa Forgings.** Covers types of forgings, applications, alloys, design and production details. 171 pages.
- ☐ **Sound Films (16 mm).**_____ (Type of fabrication.)

Aeroquip

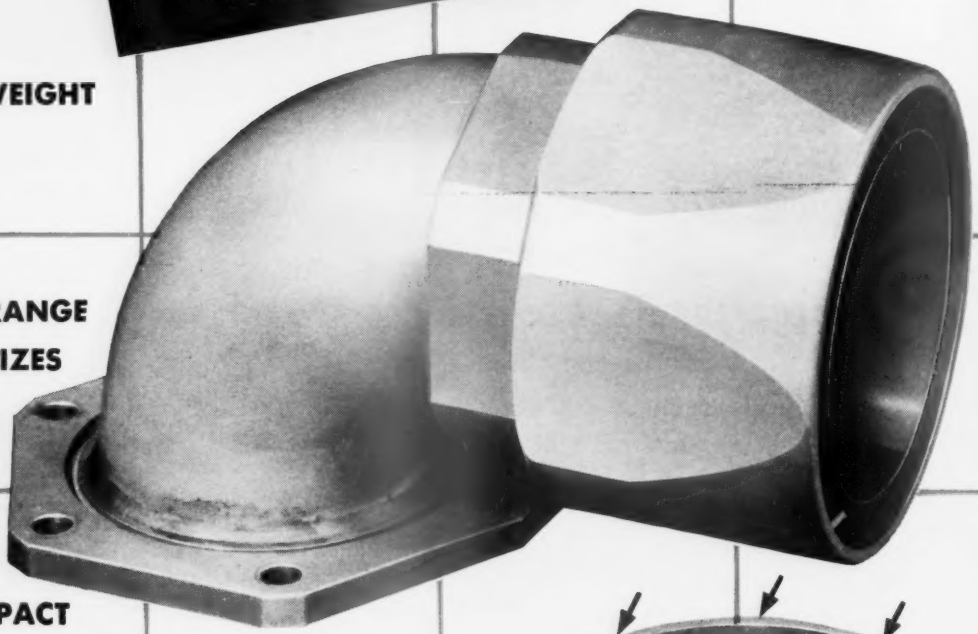
REG. TRADE MARK

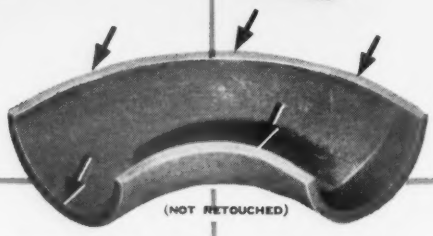
ALUMINUM ELBOWS

LIGHTWEIGHT

FULL RANGE OF SIZES

COMPACT





AN SWIVEL NUT AND FLANGE TYPES

AEROQUIP QUALITY THROUGHOUT

UNIFORM WALL THICKNESS

FULL FLOW

AEROQUIP CORPORATION

JACKSON, MICHIGAN

SALES OFFICES: BURBANK, CALIF. • DAYTON, OHIO • HAGERSTOWN, MD. • HIGH POINT, N. C. • MIAMI SPRINGS, FLA. MINNEAPOLIS, MINN. • PORTLAND, ORE. • WICHITA, KAN. • TORONTO, CANADA

AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

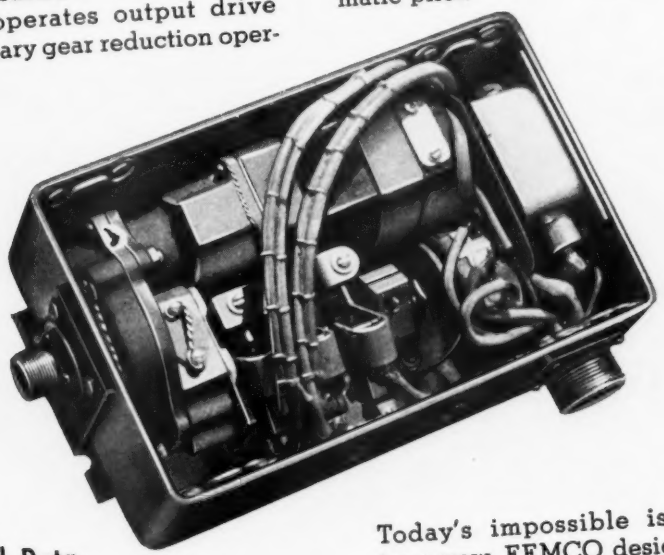
EEMCO technical bulletin

Rotary Actuator Package Advances Automatic Flight

This entirely self-contained rotary actuator package designed and built by EEMCO, combines compactness, high performance, and light weight.

Totally enclosed in a metal box equipped with mounting bracket, it incorporates motor, magnetic clutch and spring-loaded brake. Main gear reduction operates output drive shaft...auxiliary gear reduction operates three adjustable limit switches — two for limiting travel, one for neutral position indication light. Auxiliary reduction also drives potentiometer for position indication.

The unit provides continuous elevator correction on one of the latest jet fighters through the automatic pilot.



Technical Data:

Radio noise filter in accordance with AN-M-40.

Operates in ambient temperature of 250° F.

Output r. p. m. 2500 at 3 inch-pound load. Weight complete — 3¼ pounds.

Today's impossible is practical tomorrow. EEMCO design and production contribute to building electrical actuators thought impossible just yesterday.

EEMCO

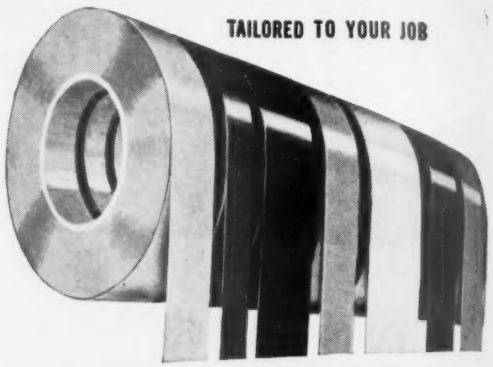
Helps You Build for the Future

ELECTRICAL ENGINEERING & MANUFACTURING CORP.

4612 WEST JEFFERSON BOULEVARD • LOS ANGELES 16, CALIFORNIA

THE NEW Polyken® INDUSTRIAL TAPES

TAILORED TO YOUR JOB



Sealing the cargo compartment of a pressurized plane cabin with *Polyken* No. 223

The tape that put a safety belt around an airplane's air!

Thanks to pressurized cabins—and a new kind of tape—the only breathtaking things about the high-altitude flights of Braniff International Airways are the service and the scenery.

Yes, we said *tape*. For tape has proved to be not only the best but the most *economical* material for sealing up door cracks, seams, and all air "escape" routes around a plane's pressurized cabin. For a job as vital as this, Braniff sought out a "tape tailored to the job."

Our engineers suggested *Polyken* No. 223. This tape, one of over 100 special *Polyken* tapes, sticks and *stays* stuck—in hot or cold, at ground level or 20,000 feet up. What's more, its tough cloth backing conforms to irregular surfaces and is extremely resistant to abrasion.

Small wonder that *Polyken* No. 223 is the tape specified for this important job on Douglas Aircraft today.

Got a tough job for tape?

We tell you the Braniff story as an example of how tape that's "tailored to your job" can do things you never dreamed tape could do. Let us study *your* problem, and we'll come up with a tape that will save you money, time and effort. That's a challenge. Won't you take us up on it?

Polyken, Dept. AEM, 222 West Adams St., Chicago 6, Ill.

For specifications, samples, and further information on this and other Polyken tapes, please send me your *FREE BOOKLET*, "Tape is a Tool."

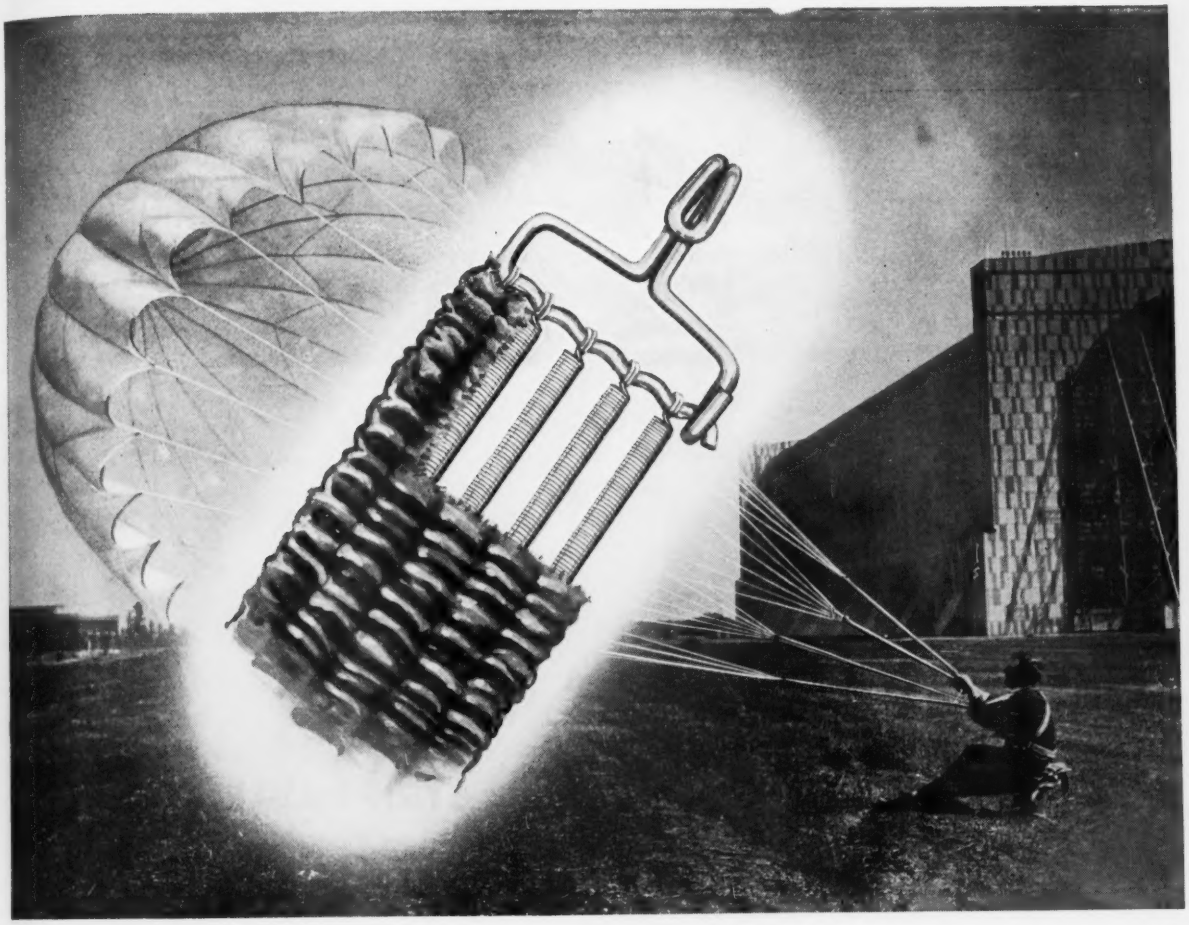
Name_____ Title_____

Company_____

Street Address_____

City_____ Zone____ State_____

Polyken Industrial Tape, Department of Bauer & Black, Division of The Kendall Company



Stainless...FOR THE SAFETY OF HUMAN LIFE!

Strap springs for all U. S. Air Force parachutes are now being made from austenitic chromium-nickel stainless steel wires that develop tensile strengths of from 300,000 to 350,000 p.s.i.

Five times as strong as structural carbon steel used in bridge construction, this stainless steel wire retains its strength at temperatures up to 500°F.

And more important . . . even when temperatures fall below zero, chromium-nickel stainless offers maximum safety because it suffers no severe loss of toughness. Unlike most ferrous metals, austenitic stainless steel retains its high resistance to impact at temperatures much lower than will be encountered in this service.

Produced by Alloy Metal Wire Company, Inc., Prospect Park, Pa., under the trade name of "Almet 302", this stainless steel spring wire assures minimum deterioration and long service life. In fact, users of stainless steel springs know from experience that there is no deterioration . . . no corrosion . . . no age embrittlement . . . no change in the original mechanical properties of austenitic chromium-nickel stainless steel.

At the present time, the bulk of the nickel produced is being diverted to defense. Through application to the appropriate authorities, austenitic stainless steels are obtainable for many end uses in defense and defense supporting industries.

EMBLEM OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

A "natural" for protection

3M STRIPPABLE COATINGS

3M strippable coatings are designed for the protection of finished metal surfaces against mars and abrasion during fabrication. These vinyl coatings form a tough, abrasion-resistant film which protects metal thoroughly.

The coatings can be applied to blank or coil stock—before fabrication or between any stage of production—and greatly facilitate the handling of metal from manufacturer to fabricator to consumer. Your metal ends up smooth and unscratched . . . requires no *expensive repolishing!*

These low-cost, fast-drying coatings are easy to work with too. They can be applied at room temperature, using standard paint spray equipment . . . and can be stripped off or blown off when protection is no longer necessary. Strippable coatings also give you an important means of reducing "rejects."

Investigate the potential of these coatings, then take advantage of their money-saving abilities. Contact the 3M field engineer in your city, or, write directly to 3M in Detroit.

3M COATING EC-968

ONE OF 1000 BETTER ADHESIVES, COATINGS AND SEALERS

USES: protects metal from scratches, mars, abrasion in various stages of storage, shipping and fabrication: protects ground, polished or plated components against abrasion and tarnishing while other parts of sub-assembly are machined: also used to protect glass or other non-porous surfaces which easily scratch or abrade.

PROPERTIES: a red-brown translucent film, easily sprayed on, easily stripped off by hand or with an air hose: synthetic resin base: solvent type: excellent resistance to water, gasoline, oil: protects metal stock during stamping, deep drawing or forming operation: coverage for one mil film is 200 to 225 square feet per gallon.

FOR MORE INFORMATION ON EC-968, AND FOR INFORMATIVE 32-PAGE BOOKLET ON ADHESIVES, COATINGS AND SEALERS, WRITE 3M, DEPT. 1212, 411 PIQUETTE AVENUE, DETROIT 2.

3M COMPANY

ADHESIVES • COATINGS • SEALERS

ADHESIVES AND COATINGS DIVISION • MINNESOTA MINING AND MANUFACTURING COMPANY

411 PIQUETTE AVE., DETROIT 2, MICH.

GENERAL OFFICES: ST. PAUL 6, MINN.

EXPORT AND CANADIAN SALES: 270 PARK AVE., NEW YORK 17, N. Y.

I. A. S. News

A Record of People and Events of Interest to Institute Members

Charles E. Wilson To Be Speaker at Honors Night Dinner

Defense Mobilizer Wilson To Speak to Aeronautical Engineers and Scientists; Awards and Honors To Be Presented and 1952 I.A.S. President Installed.

Charles E. Wilson, Director of the Office of Defense Mobilization, who will deliver the lecture at the Honors Night Dinner.

THE INSTITUTE OF THE AERONAUTICAL SCIENCES is fortunate in having the Honorable Charles Edward Wilson, formerly President of General Electric Company and now Director of the Office of Defense Mobilization, as the Guest of Honor and Principal Speaker at the I.A.S. Honors Night Dinner. The dinner will be held on Monday, January 28, the first day of the Twentieth Annual Meeting, at the Astor Hotel in New York City.

The installation of the I.A.S. President for 1952 will take place during the evening, as well as the conferring of Honorary Fellowships and Fellowships for 1951. In addition, The John Jeffries, The Sylvanus Albert Reed, The Robert M. Losey, and The Lawrence Sperry awards will be presented to this year's recipients.

As one of his last official acts, the outgoing I.A.S. President, Rear Adm. L. B. Richardson, U.S.N. (Ret.), Director of Research and Development, Fairchild Engine and Airplane Corporation, will introduce the speaker of the evening, a man who, as Vice-Chairman of the War Production Board during World War II, achieved great success in the aircraft, shipbuilding, and munitions programs and who, in his present capacity as Director of Defense Mobilization, controls the destiny of the aircraft industry.

▸ **The Speaker**—Mr. Wilson, whose life story reads like that of a Horatio Alger hero, is a product of New York City's lower west side. The death of his father forced the early termination of his formal schooling, so that at the age of 12 he was employed as an office boy for Sprague Electric Company, New York, one of the organizations that went to make up General Electric.

At Sprague, Mr. Wilson advanced slowly from office boy through the shipping room to factory accountant, production manager, assistant factory superintendent, and, finally, sales manager. He attended night school to learn cost accounting and general accounting and enrolled in successive correspondence courses in engineering. The cost of his course in electrical engineering he defrayed by tutoring students in physics, mathematics, and other courses he had already completed.

In 1919, the year after the conduit business was transferred from Sprague to G-E, he was made Assistant General Superintendent of the company's Maspeth, L.I., and New Kensington, Pa., works. Four years later, he went to Bridgeport, Conn., as Managing Engineer in charge of the conduit and wire business, and, in 1926, he was appointed Assistant Manager of G-E's Bridgeport works.

After the elapse of two years, Mr. Wilson was named Assistant to the Vice-President in charge of the Merchandise Department at G-E. In 1930, he became Manager of the Merchandise Department in charge of engineering, manufacturing, and sales. In December of the same year, he was elected Vice-President and was one of the members of the newly formed appliance sales committee. In 1935, he was assigned the additional responsibility of directing all appliance activities.

In 1937, he was returned to New York City as Executive Vice-President and, as such, was responsible for all company departments. Two years later, he was elected President of the company and assumed that office on January 1, 1940.

From September, 1942, to September, 1944, Mr. Wilson severed his connections with G-E to serve as Vice-Chairman of the War Production Board. Upon returning to his prewar work, Mr. Wilson was once again elected a director and President of General Electric.

When Mr. Wilson resigned as G-E's fourth President on December 15, 1950, to take over his present duties, he had completed more than 51 years of service with G-E.

Mr. Wilson has been the recipient of many awards, including the Medal of Merit and the Air Force Exceptional Service Award. Fourteen different colleges and universities have conferred upon him eight honorary degrees as Doctor of Law, four as Doctor of Engineering, one as Doctor of Science, and one as Master of science. He has served as a member of many governmental committees and organizations.

I.A.S. 20th Annual Meeting

Technical Programs for 5-Day Meeting Planned; Other Engineering Groups Cooperate in Sessions.

As 1952 approaches, the Institute of the Aeronautical Sciences is making extensive plans for the Twentieth Annual Meeting. Five days of technical sessions (rather than four, as in the past) will be held at the Astor Hotel in New York City from January 28 to February 1, 1952, inclusive.

Featured at the meeting will be certain technical sessions that the Institute is presenting in cooperation with seven other engineering groups. These seven are The Soaring Society of America, Institute of Radio Engineers, Radio Technical Commission for Aeronautics, Institute of Navigation, American Meteorological Society, American Helicopter Society, and American Rocket Society. The technical sessions in question are those on soaring, electronics in aviation, meteorology, rotating wing, and rocket propulsion.

▶ **Electronics**—Last year, for the first time at an I.A.S. annual meeting, two sessions were given over completely to the subject of electronics. The interest shown in this innovation was so widespread that an entire day of the Twentieth Annual Meeting will be devoted solely to the problems, trends, etc., attending electronics. The morning session will cover the "Impact of Electronic Trends in Aircraft Design." "Problems Encountered in Today's High-Speed Flights" will be the concern of the afternoon session. In the evening, a symposium on "All Weather Operations Problems" will be presented.

The plans for the Institute's day of electronics in aviation were made by a special planning committee that is composed of representatives of the Institute of Radio Engineers, Radio Technical Commission for Aeronautics, Institute of Navigation, and the Institute of the Aeronautical Sciences. The representatives of these societies are L. G. Cumming, D. S. Little, and D. K. Martin from the I.R.E.; G. Rappaport of the I.R.E. Professional Group on Airborne Electronics; E. F. Herzog and L. M. Sherer from the R.C.T.A.; P. Rosenberg of the I.O.N.; and K. C. Black and Robert R. Dexter of the I.A.S.

The sessions on soaring, meteorology, rotating wing, and rocket propulsion will be presented by the I.A.S. with the Soaring Society, A.M.S., A.H.S., and A.R.S. cooperating, respectively.

The remaining sessions comprising the Twentieth Annual Meeting will be concerned with the subjects of aerodynamics, aeroelasticity, structures, design, air transport, and jet propulsion. During the session on aeroelasticity, some highly interesting films of flutter models under actual tests will be shown. For further details of the annual meeting program, see the tentative time schedule on this page. The final programs for this meeting should be in the mail by the end of December.

▶ **Programing**—The overall programing for the forthcoming meeting was accomplished by members of the National Meetings Committee under the Chairmanship of T. P. Wright. Other members of this committee are F. A. Cleveland; John H. Collins, Jr.; Hugh L. Dryden; Charles Froesch; Martin Goland; Nicholas J. Hoff; Willson H. Hunter; Richard Hutton; R. D. Kelly; Jerome Lederer; E. E. Lundquist; Harold Luskin; W. R. Sears; Abe Silverstein; R. Dixon Speas; and Ernest G. Stout.

Tentative Time Schedule

Monday January 28	Tuesday January 29	Wednesday January 30	Thursday January 31	Friday February 1
Registration: 8:30 A.M.	Registration: 8:30 A.M.	Registration: 8:30 A.M.	Registration: 8:30 A.M.	Registration: 8:30 A.M.
Aerodynamics I 9:00 A.M.–12:00 Noon	Aeroelasticity 9:00 A.M.–12:00 Noon	Electronics in Aviation I† 9:00 A.M.–12:00 Noon	Meteorology‡ 9:00 A.M.–12:00 Noon	Rocket Propulsion†† 9:00 A.M.–12:00 Noon
	Soaring* 9:00 A.M.–12:00 Noon		Rotating Wing** 9:00 A.M.–12:00 Noon	
Luncheon: 12:30 P.M.	Luncheon: 12:30 P.M.	Luncheon: 12:30 P.M.	Luncheon: 12:30 P.M.	Luncheon: 12:30 P.M.
Aerodynamics II 2:00–5:00 P.M.	Structures 2:00–5:00 P.M.	Electronics in Aviation II† 2:00–5:00 P.M.	Air Transport 2:00–5:00 P.M.	Jet Propulsion 2:00–5:00 P.M.
		I.A.S. Business Meeting 5:00 P.M.		
		Council Dinner 7:00 P.M.		
Honors Night Dinner 7:30 P.M.	Design 8:00–11:00 P.M.	Electronics in Aviation Symposium† 8:00–11:00 P.M.	Smoker 8:00–11:00 P.M.	

* Soaring Society cooperating.
† Institute of Navigation, Institute of Radio Engineers, and Radio Technical Commission for Aeronautics cooperating.
‡ American Meteorological Society cooperating.
** American Helicopter Society cooperating.
†† American Rocket Society cooperating.

M. W. Kellogg Joins I.A.S.

The M. W. Kellogg Company became a Corporate Member of the Institute of the Aeronautical Sciences in September. It is now one of about 150 concerns holding such membership in the I.A.S.

Insofar as the aeronautical field is concerned, The M. W. Kellogg Company is currently engaged in classified research, development, and fabrication of liquid and solid propellant rocket devices for the U.S. Armed Services. Some of the research now being conducted is on liquid rocket propellants, while the developmental work includes liquid propellant boosters and rocket engines for assisted take-off and flight of military aircraft. In addition, advanced designs to obtain higher impulse to weight ratios are also being furthered.

In order to handle this type of work, a Special Projects Department was established in 1945 at the Jersey City plant of The M. W. Kellogg Company. Extensive laboratories and rocket-test facilities were erected to house the work of this particular department, which counts among its earlier projects the experimental development of turbojet and ram-jet burner designs.

Solid propellant booster rocket and JATO cases are being fabricated for all of the military services in the M. W. Kellogg shops.

Greater New York Safety Convention and Exposition

The 22nd Annual Safety Convention and Exposition is scheduled to be held in two New York City hotels, the Statler and New Yorker, from April 1–4, 1952, inclusive. With 50 sessions being planned in traffic, industry, school, and home safety, this coming convention and exposition promises to surpass the last one in scope, interest, and attendance.

As in the past, the convention and exposition is being put on by the Greater New York Safety Council, Inc. The Institute of the Aeronautical Sciences is one of 70 cosponsoring organizations.

A.A.A.S. Holds Annual Science Exposition and Conference on Scientific Manpower

The American Association for the Advancement of Science has included a Conference on Scientific Manpower in its program for the meeting at Philadelphia in December of this year. This particular conference was organized to bring before the A.A.A.S. some of the crucial problems involving scientific manpower in the fields of physical, biological, engineering, and social sciences.

"Supply and Demand," "Post-Baccalaureate Training," and "Selection Techniques: Psychological Background" will be the topics under discussion on December 28, 29, and 30, 1951, respectively. The meetings will be called to order in each instance at 9:30 a.m. in the Bellevue Stratford Burgundy Room.

The Engineers' Club of Philadelphia, the Engineers' Council for Professional Development, Sections "I," "K," and "M" of the A.A.A.S., and the Association's Cooperative Committee on the Teaching of Science and Mathematics are jointly sponsoring the conference.

News of Members

▸ **Mark H. Clarkson** (M.) was awarded a predoctoral fellowship in aeronautics for the 1951–1952 academic year. He is taking his work at the University of Manchester, England. Mr. Clarkson was Research Engineer, Defense Research Laboratory, University of Texas.

▸ **Ralph S. Damon** (F.), President, Trans World Airlines, Inc., was elected a Director of the National Safety Council at the annual meeting of the National Safety Congress in Chicago.

▸ **Paul A. Dennis** (A.F.), of Douglas Aircraft Company, Inc., is directing a compilation of approximately 25 radome shapes for the Aircraft Research and Testing Committee, Aircraft Industries Association of America, Inc. The object is to enable designers to evaluate the performance of a radome whose geometry falls near the range of existing industry practice.

▸ **Lieutenant Peter C. Johnson** (T.M.) received the silver wings of an F-80 jet fighter pilot during the graduation exercises of Class 51-F at the Jet Fighter School, Williams Air Force Base, Ariz.

▸ **Robert J. Minshall** (F.), who is President and General Manager of Pesco Products Division, Borg-Warner Corporation, as well as President of Borg-Warner's newly created Wooster Division, will head the manufacturing operations at Wooster, where a new 104,000-sq.ft. plant is being erected on a recently purchased 32-acre site. This $2,000,000 facility will be used for the manufacture of electrically driven hydraulic and fuel pumps for jet engines.

▸ **Dr. Glenn Murphy** (M.), Professor of Theoretical and Applied Mechanics, Iowa State College, was presented with the George Westinghouse Award for 1951 by The American Society for Engineering Education. The citation reads: "To Glenn Murphy, a master craftsman of the teaching art. Unsparing of himself, he develops in his students at each level of age and background the desire and ability to think; an eagerness to learn; a willingness to work. An exacting task master, a prolific writer, a skillful improvisor, an able supervisor of junior colleagues, he advanced teaching along the broad front of precept, example, and a genuine personal interest in each student with whom he has contact."

▸ **Dr. S. Neumark** (A.F.), Principal Scientific Officer, Royal Aircraft Establishment, Hampshire, England, was awarded the Orville Wright Prize by the Royal Aeronautical Society for his paper on sweptback wings.

▸ **Lieutenant Charles L. Nuschke** (T.M.) received the silver wings of an F-80 jet fighter pilot during the graduation exercises of Class 51-F at the Jet Fighter School, Williams Air Force Base, Ariz.

▸ **Archibald Edward Russell** (F.), Chief Designer, Aircraft Division, Bristol Aeroplane Company, Ltd., England, was presented with the British Gold Medal by the Royal Aeronautical Society for practical achievement in aircraft design.

▸ **Alvin H. Sacks** (M.), who was Aeronautical Research Scientist at Ames Aeronautical Laboratory, N.A.C.A., Moffett Air Force Base, Calif., is a predoctorate fellow in aeronautics at École Nationale Supérieure de l'Aéronautique, France, for the 1951–1952 academic year.

▸ **Dr. Robert H. Scanlan** (M.) was awarded a postdoctoral fellowship in aeronautics for study at École Nationale Supérieure de l'Aéronautique, France, for the 1951–1952 academic year. Dr. Scanlan was Associate Professor of Aeronautical Engineering, Rensselaer Polytechnic Institute.

▸ **Dr. Leo Schapiro** (M.), of Douglas Aircraft Company, Inc., has been designated Chairman of a subcommittee of Aircraft Research and Testing Committee, Aircraft Industries Association of America, Inc. This subcommittee exists for the purpose of permitting the rapid evaluation of boron steels as they are introduced into the aircraft industry. Dr. Scha-

(*Continued on page 58*)

Message from Britain*

"The charm of aeronautics is its restlessness; it never remains stable or static for five minutes but is always on the change.... The fact remains, however, that aeronautics is almost obsolescent and is rapidly becoming true ballistics. Already a planetary society has started in London. A sort of newspaper is produced once a month, containing most attractive information and indicating which planet is the most attractive to stay on for a short holiday. Recently, I have been talking to my friend, Mr. Hubble, the great astronomer, and have had with him some cosmological chats. He has talked of producing the perfect vehicle in which to travel to the moon or elsewhere. In interstellar space, however, especially moving around the sun, there are particles of matter varying from the size of a golf ball to that of Ellis Island and traveling rather faster than a bullet. The chances are about three to one against the vehicle being hit. I have reluctantly come to the conclusion that I am not going to the moon; no doubt winter sports there are very admirable, but St. Moritz for me!

"The great Prince Bismarck remarked, in about the year 1875, that the most significant thing in the world was that Great Britain and America spoke the same language. That phrase about speaking the same language has a narrower meaning today, but it is just as powerful as it ever was. It is indeed of transcending importance.

"I recall the first meeting of P.I.C.A.O., when I led the British team. That team was seated at a very cosmopolitan table opposite the Americans, and I felt that they were about the toughest lot I had ever seen. No doubt they thought the same of the British team, and we scowled at each other. I had to make the first speech, and I stated plainly that the British were not going to be bullied by the Americans; in return, they said they were not going to be coerced by anybody from Britain. Then we formed committees. The admirable institution known as "elevenses" was of great benefit, for we all drank coffee together. After about two days, we were calling each other by our Christian names; and ever since then, we have been devoted friends. As a result of the creation of that spirit,

* Excerpts from Lord Brabazon's proposal of the toast to the Institute at the dinner of the Third International Conference, Brighton, England, September 7, 1951.

A Guest Editorial by Lord Brabazon of Tara

many technical problems that arose were resolved by personal letters between friends.

"Americans love America, and there are many English people who also love America. I wish there were more facilities for English people to go there; the exchange control makes it difficult for us to do so. It is refreshing for an Englishman to arrive in America; one is impressed by the invigorating freshness of life there, by the lack of cobwebs. The people there are of the kindest and sweetest in the world. Some British people have gained impressions from the cinema, such as that there are gangsters shooting each other in every street corner, which are quite erroneous. On one occasion, on a journey from Toronto to Rochester, I met an Immigration Officer who I thought would be rather difficult. But, in fact, that officer proved to be the nicest man I ever met; we dined together, and we still send one another Christmas cards.

"What wonders you have accomplished in America relative to aviation, and is it not right that you should so do, for it was in America that flight was born.

"There are people here tonight at this dinner who knew and loved both Wilbur and Orville Wright, and we are proud to think that in their turn they had an affection for us, for did not their first machine rest in our great Science Museum for over 20 years—the most marvelous museum piece in the world.

"What pleasure it gives us to see you here. We marvel at your technological progressiveness, unrivaled in the world, pressing along at bewildering speed.

"I wonder what you will think of us in your hearts, from a technical point of view. Comparisons are odious; consequently, all we wish to hope is that you will consider us a worthy yardstick by which you can measure your own achievements.

"You technicians from both countries will get on well together; you speak the same language—this time in the second sense. But I wonder what you will think of the people of this country and what you will tell about them to your friends on your return.

"You will, perhaps, remind them that this country was once the greatest, proudest, and the richest country in the world. Two wars, not of our own making, have bled us white. We sacrificed the best of our manhood, which should now be taking charge of the country, in the Battle of the Somme and other battles of the First World War, and our vast treasure has now been dissipated. This country is not used to living on charity, but it has done so on yours for many years. What help and understanding has been given by you, and with such grace and so openhandedly! Never in the history of the world has such generosity been shown, as has been done by the United States.

"Not only are you great, geographically, but you are great in spirit. Look at the recent Peace Treaty with Japan. After the treachery inflicted upon you, the horrors that you have endured, and the loss of life it cost you to win, you have returned, in the Peace Treaty, good for evil. Surely there cannot be one citizen of the United States who is not proud, and rightly so, of his country.

"You will tell your friends that you have seen a country here, down in the dumps a little, not seeing things very clearly, having lost, for perhaps a time, their old political wisdom, but at heart, sound. You will tell them that there have been bad times before and they got over them and will do so again. But there is one tremendous change that has taken place—gone forever is that idea of Great Britain living in splendid isolation for the reason that it was an island. The old Blue Water School has died. When Bleriot crossed the Channel, the whole geographical situation changed; we are now just the last bit of Western Europe. The Channel has disappeared, and the great Atlantic is becoming less and less of a barrier to be crossed. The result is that it is at least realized, I believe, both here and in America, that our destiny and yours are forever linked together. We have the same heritage, the same way of life, the same love of freedom, and the same love of initiative and independence, and there are none here or in America who would not rather perish than tolerate the introduction of the 'police state.' You will, perhaps, tell your friends these things about this small island, saying that they are at the moment perhaps harassed and perplexed, but will you end up with this note? That, small as we may be, we have been in the past, and we intend to remain in the future, forever 'Great' Britain."

Impressions of the

THIRD ANGLO-AMERICAN *Aeronautical Conference*

by

Welman A. Shrader

Brighton-London

September 3–14

1951

Departing from New York's International Airport on regularly scheduled flights of Pan American Airways and Trans World Airlines, four parties of American delegates to the Anglo-American Conference made the crossing to London via air. The first group *(left)*, with I.A.S. President Adm. L. B. Richardson and Director S. Paul Johnston as conductors; and the second group *(above)*, conducted by the Institute's Secretary, Robert R. Dexter, left New York September 1.

On Sunday, September 2, the third and fourth parties *(left and above)*, conducted by the Institute's Controller, Joseph J. Maitan and Director of Publications, Welman A. Shrader, respectively, boarded other P.A.A. Stratocruiser and T.W.A. Constellation flights for the pleasant journey across the Atlantic. Forty-eight people in all, 37 delegates and 11 wives, comprised the four groups. (For the complete list of American Delegates who attended the Conference, see page 34.)

THE THIRD OF THE JOINT SESSIONS on aeronautics between our friends on the other side of the Atlantic and some 100 American delegates from the I.A.S. was a huge success. Both from the technical and social standpoint the inter-exchange of ideas and friendly amenities proved of benefit to all concerned. Whether one was touring the Downs of Sussex or attending the lectures in Brighton, a feeling of kinship and mutual understanding permeated the atmosphere.

Americans learned that the interests, problems, and ultimate objectives of our British friends are much the same as our own. The chief differences lie in our customs and habits—dictated by tradition and geographic location. No one found these differences insurmountable. Americans loved the Britisher's ice cream and tea—detested his coffee; admired his beautiful flower gardens—and was baffled by his currency. Unanimously they agreed, however, that he does have a sense of humor, is a master at rebuttal, and proved a perfect host under numerous patience-trying circumstances.

Not the least of these latter involved the gathering-up of American delegates, their wives, children, and baggage, and depositing them safely in Brighton. Arriving by ship and plane—from Southhampton to London at all hours of two days and nights—each one was met and transported to the Grand Hotel without the loss of a single delegate—no mean achievement in itself and a credit to the organization and perspicacity of R.Ae.S. staff personnel.

BRIGHTON BACKGROUND

The selection of Brighton as a setting for the technical meetings was the result of two unrelated coincidents—crowded hotel conditions in London being the first. No one is quite sure of the second, although it naturally involves that guiding genius of the conference and the R.Ae.S., Capt. J. Laurence Pritchard. Whether it was an affinity for the fine paintings in the Royal Pavilion, a natural love for his "home town," or the desire to write another book, Laurence had valid reasons for his choice.

Brighton proved to be an interesting—if contrasting—place to hold a series of technical discussions on anything so modern as aeronautics. Its age-old buildings, modern amusement piers, narrow lanes, and expansive parks fired the imaginations of visiting delegates and gave rise to many self-escorted exploration parties. For here the Romans had trod 14 centuries before Columbus discovered America.

The memories of Brighton will always be cherished—East Street, the Lanes, Grand Hotel, Old Steine, the

Royal Pavilion, Western Road, and the "The Spirit of Brighton." These, and many more, will be topics of conversation among guests at the conference for years to come. To stimulate these memories, one has but to refer to Laurence Pritchard's inimitable little "ABC" booklet on Sussex, thoughtfully prepared for the guidance of conference visitors.

CONFERENCE ACTIVITIES

The week at Brighton was jam-packed with scheduled events from the opening to the closing of the technical portions of the conference. On Monday evening, September 3, the reception at the Grand Hotel gave all delegates from England, the United States, and elsewhere an opportunity to become acquainted, renew old friendships, and break the ice in general.

The formal opening of the technical sessions took place in the Dome, adjoining the Corn Exchange, the following morning. Here, Major F. B. Halford, President of the Royal Aeronautical Society, welcomed the delegates to the Third Anglo-American Aeronautical Conference and commented on the growth of the Conference since its inception in 1947. He pointed out that there were 106 delegates from America this year as compared to 42 in 1947.

Major Halford then read a welcoming message from the Prime Minister and concluded by thanking the Mayor of Brighton, whom he had introduced earlier, and the I.A.S. for their cooperation in making the meeting possible. He expressed the hope that the discussions would be "fierce, frank, and friendly."

Rear Admiral L. B. Richardson, I.A.S. President, in acknowledging the welcome addresses by Mayor A. E. Simms and Major Halford, stated that, while the first two conferences had been more or less experimental, their success had indicated that the event should certainly become a permanent institution. He voiced the happiness of the American delegates who were privileged to participate in this first of the second cycle of joint meetings.

Admiral Richardson then read well-wishing messages from President Truman and the Secretaries of the U.S. Navy and Air Forces. He paid tribute to Captain Pritchard, who, he said, had had so much to do with the formation of our Institute, and concluded his remarks with a warm invitation to all British delegates to visit the United States in 1953 for the Fourth Conference.

(Top photo) The Grand Hotel, official headquarters for the Third Anglo-American Aeronautical Conference at Brighton, England.

(Second) Mrs. and Mr. Christopher Clarkson are welcomed to the opening reception by Major F. B. Halford, R.Ae.S. President; Mrs. Halford; I.A.S. President Adm. L. B. Richardson; and Mrs. Richardson.

(Third) Some of the guests who gathered together for the opening reception at the Grand Hotel on the evening of September 3.

(Bottom) Taking a breather from the technical sessions at the Corn Exchange are four of the Conference principles; Robert R. Dexter, I.A.S. Secretary; S. Paul Johnston, Director of the Institute; Capt. J. Laurence Pritchard, Conference Director and retiring Secretary of the R.Ae.S.; and Dr. A. M. Ballantyne, newly appointed R.Ae.S. Secretary.

TECHNICAL SESSIONS

Following the formal opening ceremonies in the Dome, the group adjourned to the Corn Exchange for "Elevenses"—that pleasant mid-morning pause for coffee and cakes. Thus fortified, the delegates retired to the theater of the Corn Exchange to hear the first of the papers presented during the conference.

Twenty papers in all—ten British and ten American—were read and discussed during the four days of technical sessions. Since these papers and technical aspects of the Conference are more thoroughly covered by experts in the following pages of this issue, an attempt by the author to comment on them here would be redundant.

CONFERENCE PROCEEDINGS

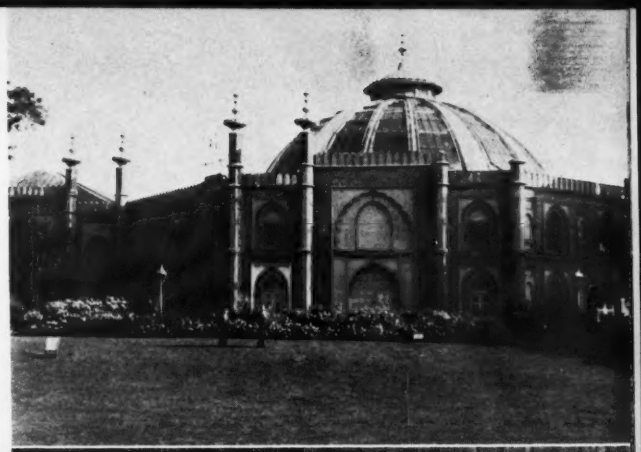
It might be noted, however, that loose-bound volumes of the proceedings, including all papers and discussions, are being published by the Royal Aeronautical Society for distribution to official delegates. A limited number of copies will be available to other interested people and libraries in the U.S. and may be obtained from the Institute in New York. Reprints of the individual papers are not, and will not be, available.

SOCIAL LIFE IN BRIGHTON

For those who were not attending lectures, and particularly for the ladies, daily bus tours and visits to some of the historic places of Sussex had been arranged. Or, if one preferred to remain in Brighton, there were chairs on the beach, golf at several local clubs, bowling on the greens, or a swim in the channel—all free to visiting delegates—through the courtesy of the City of Brighton, its Mayor, and the ever-thoughtful Mr. Pritchard.

The Lanes, that maze of narrow, crooked streets that had their origin in ancient Brighthelmstone, were popular hunting grounds for bargain-seeking Americans and British alike. At any hour of the day or night, familiar faces could be seen peering into antique-filled windows, bookstalls, and china shops or navigating the narrow passageways with package-laden arms.

To describe the daily bus tours in detail would be to write a history of Sussex. Time and space permit only a cursory treatment of a county whose known history dates back more than 1,000 years. Since 893 A.D., when the Danes entered Rye Harbour, Royalty has



(Top photo) The Dome, with the Corn Exchange adjoining it on the left, was originally built by the Regent Prince (George IV) as a stable to house his horses. Put to better use today, these buildings served to house the technical sessions of the Anglo-American Conference.

(Second) Admiral Richardson addresses the audience (see cover photo) at the opening ceremonies of the Conference in The Dome.

(Third) Daily luncheons in the Corn Exchange give Conference delegates an opportunity to exchange ideas and get better acquainted.

(Bottom) Conference delegates and their wives leave the Grand Hotel to board buses for one of the daily tours of Sussex and adjoining country.

paid homage to the beauties of Sussex. Magnificent castles, weather-worn churches, and hundreds of famous old inns stand as mute attestations to a civilization that has seen everything from feudal wars to regal pageantry.

Whether it was the ruins of Lewes Castle, the breath-taking views from the top of Devils Dyke, or the delightful little villages of Alfriston through Withyham which impressed Americans most, many were heard to remark that they intended to brush up on their English history when they reached the States.

It is impressions such as these which bring about a closer understanding between the peoples of different countries. In this respect, the social activities at Brighton proved as important and beneficial as the technical sessions.

MAYOR'S RECEPTION

An outstanding event of the conference social calendar was the reception and dance given by the Mayor and Mayoress of Brighton at the Royal Pavilion on the evening of Wednesday, September 5th. The pomp and ceremony that prologued this formal affair were in perfect keeping with the atmosphere of the Pavilion itself. Built by the Regent Prince, George IV, during an age when India and China were much in the minds of men, this fabulous "playhouse" is an unusual mixture of Oriental decoration and construction. It must be seen to be appreciated; the accompanying photograph can only hint at its ornate interior. History makes no attempt to "officially" record some of the earlier parties that were held in its ballrooms and boudoirs. But it is safe to say that Mayor Simm's reception and dance were the essence of propriety and enjoyment. The refreshments were varied, the music good, and the company excellent. Opinions differed on the quality of the general paintings hanging in the Pavilion, but Rex Whistler's "Awakening of the Spirit of Brighton" commanded more than passing attention from British and American visitors alike (further proof that there are no basic differences in the likes and thinking of both peoples—scientific or otherwise).

(Top left) **Typical of the picturesque, rolling country of Southern England is this view of the Downs taken during one of the daily bus tours.**

(Top right) **Delegates stop off on one of the tours to visit an ancient church in the small Sussex village of Etchingham.**

(Bottom left) **Major Halford, Mrs. Richardson, and Mrs. Halford and Admiral Richardson, flank the Mayor and Mayoress of Brighton, Mr. and Mrs. A. E. Simms, at the formal reception and dance given for conference delegates by the Mayor at the Royal Pavilion on September 5.**

(Bottom right) **One wing of the Royal Pavilion.**

CLOSE OF THE TECHNICAL SESSIONS

Assembling once again in the Dome, after presentation of the last paper on Friday afternoon, delegates heard Major Halford and Admiral Richardson formally close the technical sessions of the Third Anglo-American Aeronautical Conference. Messages from His Majesty, the King, and U.S. Ambassador in London, W. S. Gifford, were read to the assembly.

Both Major Halford and Admiral Richardson expressed deepest satisfaction over the caliber of papers presented and the splendid success of the sessions.

A more comprehensive description of the high key on which the conference ended is expressed editorially by I.A.S. Director, S. Paul Johnston, in the November issue of the REVIEW. [P.S. He *meant* 1953, not 1952, for the next conference!—Ed.]

(Top left) A stop for tea in the gardens of the Shelley Arms, one of the many historic inns of southern England and the former residence of the renowned poet Shelley.

(Top right) Mrs. Joan Bradbrooke, capable joint editor of the Royal Aeronautical Society's publications, and Mrs. Pike, of the R.Ae.S. staff, are dwarfed by the towering walls of famed Lewes Castle.

(Bottom left) Mrs. Grumman, Mrs. T. P. Wright, and Leroy Grumman, caught by the camera as they stroll through one of Brighton's many inviting parks.

(Bottom right) An informal shot of the formal reception that preceded the Conference Dinner and dance on September 7 at the Grand Hotel.

CONFERENCE DINNER

The week's events in Brighton were brought to a triumphant conclusion at the Conference Dinner and dance on Friday evening, September 7. Some 400 delegates, their wives, and guests jammed the Grand Hotel's dining room for the final ceremonies.

Here, I.A.S. President Richardson paid eloquent "thanks" to the Royal Aeronautical Society, the Mayor of Brighton, and to all members of both societies who had contributed so much to the success of this conference. It was his feeling that the atmosphere of friendliness—technical and otherwise—which prevailed during the first conference had increased with this one and would continue to do so. "A friendly understanding and cooperation between our two nations is the most important thing in the world today," he declared.

W. A. M. Burden, Past-President of the Institute and now a Member of its Council, proposed the toast to the Royal Aeronautical Society. Speaking warmly of the R.Ae.S., he referred to the satisfaction obtained from cooperation. He said that the two learned Societies were engaged in the creation of a tradition in the relatively new field of aeronautics and that that great tradition was symbolized by this Conference.

Major F. B. Halford, in reply, thanked Mr. Burden and remarked that few people appreciate the vital, if

minute, part played by American and British technicians in fostering the friendship between our two great countries. He referred to the Schneider Trophy Races; the Wilbur Wright Lectures; the MacRobertson Race to Australia; Ted Wright's classic 1938 lecture on aircraft production; and the advent of the gas-turbine as cases in point. The gas-turbine development, he remarked, had recently provided the "last jewel in this technical tiara of transatlantic cooperation."

Major Halford commented on the differences between the United Kingdom and the United States and said that, while the British sometimes excel in the initiation of new developments, the Americans certainly excel in the exploitation of volume production. The value of combining these qualities is obvious. He continued, however, to point out that, unless watched, security could become a bogey. It was his feeling that the faster the speed of technical progress, the less damage leakages could do.

Before concluding, Major Halford read a congratulatory message from Mr. Winston Churchill and a cable from the Institute's founder, Mr. Lester D. Gardner.

Lord Brabazon of Tara, proposing the toast of the Institute, gave a delightful and humorous speech that impressed the delegates from both sides of the Atlantic. Excerpts from his talk are presented as this month's Guest Editorial and will be found elsewhere in this issue.

The Institute's Director, S. Paul Johnston, was glad to have the opportunity to express appreciation on behalf of the entire American delegation of the magnificent job that had been done by the Royal Aeronautical Society in general and by Capt. Laurence Pritchard in particular, in arranging this Conference. After an amusing and apt parody of Lewis Carroll's writings, Mr. Johnston said that those in America had been extremely fortunate in having to deal with someone in England who really did understand their curious ways.

Making his last official speech in connection with the Society, Capt. J. Laurence Pritchard thanked Mr. Johnston, spoke warmly of his friends on both sides of the Atlantic, and gave a number of amusing reasons why he would not be averse to being an American.

In spite of his usual witty tongue and his laughter-provoking reference to Charles Grey as the only man in aviation who always puts the "C.G." in the proper place, Capt. Pritchard's farewell address was delivered with a light-heartedness that belied the feelings of both himself and his audience. It is with a mingled sense of regret, yet appreciation for a job magnificently done, that his friends see him retire from active duty as Secretary of the Royal Aeronautical Society.

The dance, which immediately followed the dinner, was highlighted by featured performances of typical English and American dances. This enjoyable affair ran on into the wee hours and brought the week in Brighton to a most successful conclusion.

A LESSON IN SHAKESPEARE

A majority of the delegates took advantage of an interesting week-end tour of the Shakespeare country which had been arranged for their entertainment. Driving by coach from Brighton, three different groups of Americans got to see much of southern England's scenic countryside and villages during the seven-hour ride to Stratford-on-Avon.

Here, at the home of William Shakespeare, they visited the many spots of beauty that had inspired the great Bard in his writings. Shakespeare's birthplace, Ann Hathaway's cottage, the old mill on the Avon, and many other points of interest in and around Stratford stirred the imaginations of the Americans and set them in the proper mood for the evening's entertainment. This consisted of a splendid performance by some of England's most outstanding Shakespearean

(Bottom left) **Ann Hathaway's cottage and gardens at Stratford-on-Avon.**

(Bottom right) **Warren Baker, Socony-Vacuum's Aviation Manager, pauses to take some shots of the Royal Aeronautical Society's hard-working Florence Barwood against the background of the Welcome Inn and its beautiful gardens at Stratford.**

(Opposite page, bottom left) **Blenheim Castle, at Woodstock, gives the delegates an opportunity to see how English Nobility fared in the eighteenth century.**

actors in "King Henry V" at the Shakespeare Memorial Theater.

LONDON VIA OXFORD

Leaving Stratford on Sunday morning, the group motored to Oxford, stopping en route for a brief visit to Blenheim Castle, at Woodstock. This imposing structure was completed in 1722 for the Duke of Marlborough and is still in a perfect state of preservation and active use.

Oxford, with its 23 colleges and architecturally beautiful buildings and churches, was the object of extensive exploration by all Americans on Sunday afternoon. More than a few Institute members are graduates of this famous school, so the tours of Magdalene, Oriel, Christ, and other colleges of Oxford held more than passing interest for the visitors.

It was not until dinner time on Sunday that tired but steeped-in-English-history groups of Americans were dropped off at their respective hotels in London.

LONDON PROGRAM

Whether it was the belief that Americans have the stamina of their forefathers or the fear that they might try to "take over" the city of London if left to their own devices, the program layed-on by the R.Ae.S. for the second week of the Conference was, if anything, more strenuous (and interesting) than the first.

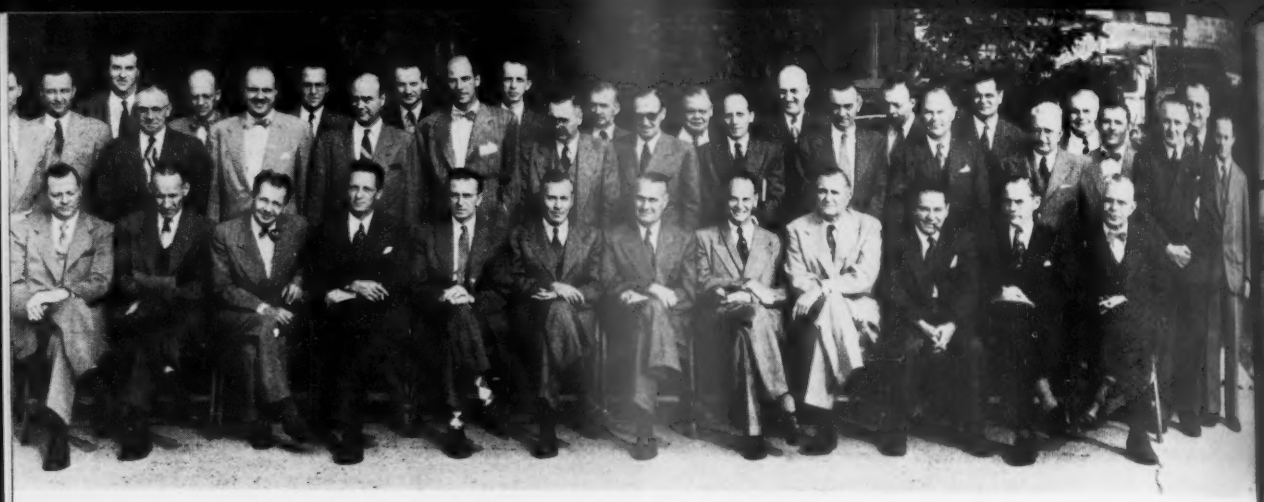
Day-long tours of aircraft plants, laboratories, and the S.B.A.C. show were scheduled for every day in the week. Several receptions and the Wilbur Wright Memorial Lecture brought all of the delegates together again on three different evenings.

(Top photo) **A view of Oxford on a cloudy Sunday afternoon.**

(Second) **In the courtyard of one of Oxford's 23 colleges, delegates receive a briefing on the sights they are about to see.**

(Third) **A familiar scene in front of the R.Ae.S. building in London as delegates board buses for the daily tour of some aviation facility.**

(Bottom right) **After a splendid lunch at de Havilland's guest house, near Hatfield.**



The full group of Americans who spent the day of September 11 touring the aircraft and engine plants of de Havilland Enterprise.

PLANT VISITS

Every thought was given to the comfort, convenience, and enjoyment of the delegates in arranging for the visits to the various installations. Private coaches were employed to convey the groups to and from R.Ae.S. headquarters at Hamilton Place. The luncheons, receptions, and general hospitality at each plant visited left nothing to be desired.

While space does not permit a detailed account of each tour, there is no doubt that every American visitor came away with a deeper respect and appreciation of England's aircraft industry and the people connected with it.

The schedule of plants and facilities visited is as follows:

Monday, Sept. 10	**—College of Aeronautics, Cranfield**
	—National Physical Laboratory, Teddington
Tuesday, Sept. 11	**—de Havilland Engine and Aircraft Works**
Wednesday, Sept. 12	**—S.B.A.C. Show, Farnborough**
Thursday, Sept. 13	**—Hawker Aircraft Co., Kingston**
	—Bristol Aircraft and Engine Works, Bristol
Friday, Sept. 14	**—Vickers-Armstrong Ltd., Weybridge Works**
	—Rolls-Royce, Derby

It was apparent from these tours that the British are doing a magnificent job of research and development in aeronautics. What they lack in equipment and research facilities, as compared to the U.S., is offset by a skill and ingenuity that will always keep them well up in front in this field.

More general information on some of the research being carried on in England at the present time will be found in the articles that follow.

S.B.A.C. SHOW AT FARNBOROUGH

If there was any doubt in any American's mind about the aeronautical abilities of our English friends, it was certainly dispelled at Farnborough on September 12. The Conference delegates, as guests of the Society of British Aircraft Constructors, spent the entire day viewing static and flying displays unrivaled by any similar show on earth.

The static exhibitions, housed in a huge tent at the airfield, displayed all kinds of aircraft materials and products, from rivets to engines. The arrangement and dramatizations of each booth were top-quality showmanship.

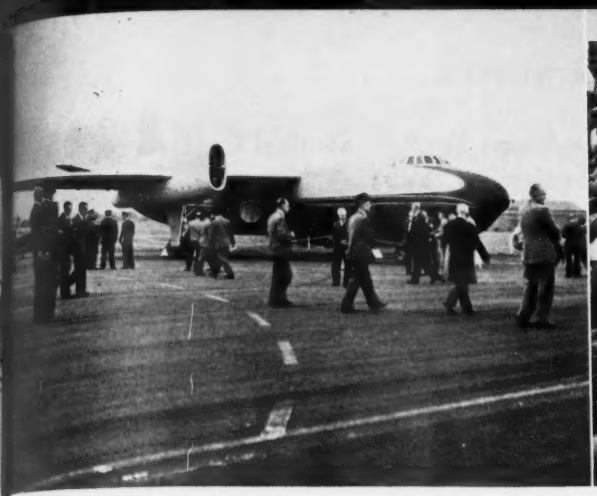
On the flight line, each and every airplane participating in the show was available for inspection during the morning hours. In the afternoon, all were flown in awe-inspiring exhibitions that proved the mettle of both aircraft and pilots.

Descriptions of the airplanes participating in this Twelfth Flying Display of the S.B.A.C. are a subject beyond the scope of this report. Such descriptions are available in numerous places, however, and are worthy of further investigation by I.A.S. members.

WILBUR WRIGHT MEMORIAL LECTURE

On Monday evening, September 10, the Thirty-Ninth Wilbur Wright Memorial Lecture was given by Arthur

Captain J. Laurence Pritchard and S. Paul Johnston in front of the S.B.A.C. President's tent at Farnborough.



(Left) Among the aircraft on public display for the first time at Farnborough was this Short S.A.4, four-jet bomber. *(Right)* Delegates of the I.A.T.A. and R.Ae.S.-I.A.S. Conferences in London enjoy front-row seats at the S.B.A.C. show.

Raymond, Vice-President, Douglas Aircraft Company, Inc., at the auditorium of the Royal Institution. Moved back from its usual date so as to coincide with the Anglo-American Conference, the lecture was heard by more Americans this year than ever before. Judging from the closing remarks made by Major G. P. Bulman and Captain Pritchard, this was also one of the finest Wright Lectures ever delivered.

Mr. Raymond chose as his subject, "The Well-Tempered Aircraft," which turned out to be an extremely interesting and valuable treatise on "what to do and what not to do" in designing airplanes. The paper, based largely on his 30-year record with Douglas, cited examples and experiences that can be exploited to advantage by every designer in the business today. Mr. Raymond's lecture is being published by the Royal Aeronautical Society.

The "Big 3" of the Anglo-American Conference, Capt. J. Laurence Pritchard, Major F. B. Halford, and Adm. L. B. Richardson.

The Society's Gold Medal and other annual awards and honors were presented to the respective recipients just before the lecture.

RECEPTIONS IN LONDON

Following the Wright Lecture, an "open house" and reception were held for the Conference delegates at the Society's headquarters building, 4 Hamilton Place. Major and Mrs. F. B. Halford and the Council and their ladies were hosts on this occasion.

A wide variety of delicious foods and drinks, a showing of movies taken during the preceding week at Brighton, and tours of the Society's building all added up to a most enjoyable evening.

There were numerous private dinners and informal get-togethers of different groups throughout the week.

On Thursday, September 13, His Majesty's Government gave a reception at Lancester House for the Conference delegates. This formal affair marked the last social function of the Conference.

IN RETROSPECT

It was with mingled feelings of regret, yet satisfaction over "mission accomplished," that the delegates took leave of the Conference on September 14. Scattering to the four winds, many took off for a holiday or business on the Continent; others returned to their homelands or remained in England for further work.

In any case, the passing weeks since September have brought innumerable indications that the Conference was a huge success. American delegates have been unanimous in their praise of the program and the efficient manner in which it was handled by the R.Ae.S. staff. It is the feeling of all that the time spent in England was well worth while.

Our British contemporaries have given us a tough target to shoot at in 1953. But with their good example and the enthusiastic support of this year's delegates, the Fourth Anglo-American Conference should further strengthen our bonds of friendship and mutual interests in advancing the progress of the aeronautical sciences.

American Delegates to the Third Anglo-American Aeronautical Conference Brighton–London, September, 1951

E. E. Aldrin, Aviation Manager, Atlas Supply Company
B. N. Ashton, President, Electrol, Inc.
Warren L. Baker, Manager, Socony-Vacuum Oil Company, Inc.
Preston R. Bassett, President, Sperry Gyroscope Company
W. B. Bergen, Vice-President-Chief Engineer, The Glenn L. Martin Company
George Brady, Director of Engineering, Propeller Division, Curtiss-Wright Corporation
W. A. M. Burden, Special Assistant to the Secretary of the Air Force, Department of the Air Force
Neil Burgess, Assistant Manager of Engineering, Aircraft Gas Turbine Division, General Electric Company
John H. Carter, Colonel, U.S.A.F., Deputy Director of Research and Development, Directorate of Research and Development Office, DCS/DEV Hdqs., U.S.A.F.
Thomas A. Combs, Rear Admiral, Chief, Bureau of Aeronautics, Department of the Navy
John W. Crowley, Associate Director, N.A.C.A.
Vernon Crudge, The Munitalp Foundation, Inc.
Robert R. Dexter, Secretary, the Institute of the Aeronautical Sciences
Ivan H. Driggs, Director, Research Division, Bureau of Aeronautics, Department of the Navy
Hugh L. Dryden, Director, N.A.C.A.
Louis G. Dunn, Director, Jet Propulsion Laboratory, California Institute of Technology
Herman H. Ellerbrock, Jr., Chief, Turbine Cooling Branch, Lewis Laboratory, N.A.C.A.
Laurence D. Ely, Lt. Colonel, U.S.A.F., Headquarters, Wiesbaden, Germany
Allan D. Emil, Counsel, the Institute of the Aeronautical Sciences
William R. Enyart, President, Simmonds Aerocessories, Inc.
Frank W. Fink, Chief Engineer, Consolidated Vultee Aircraft Corporation
A. H. Flax, Head, Aerodynamics Department, Cornell Aeronautical Laboratory
Wendell S. Fletcher, President, Fletcher Aviation Corporation
John F. Floberg, Assistant Secretary of the Navy for Air
F. N. Frenkiel, Physicist, Applied Physics Laboratory, Johns Hopkins University
I. E. Garrick, Chief, Dynamics Loads Division, Langley Aeronautical Laboratory, N.A.C.A.
D. Gerdan, Chief Engine Engineer, Allison Division, General Motors Corporation
L. M. Grant, Rear Admiral, Bureau of Aeronautics, Department of the Navy
Leroy R. Grumman, Chairman—Board of Directors, Grumman Aircraft Engineering Corporation
Stedman S. Hanks, Trustee, American Flight Strips Association
N. J. Hoff, Head of Department of Aeronautical Engineering and Applied Mechanics, Polytechnic Institute of Brooklyn
John J. Ide, Aeronautical Consultant, N.A.C.A.
S. Paul Johnston, Director, the Institute of the Aeronautical Sciences
J. W. Larson, Chief Engineer, Fort Worth Division, Consolidated Vultee Aircraft Corporation
Fred P. Laudan, Vice-President—Manufacturing, Boeing Airplane Company
Robert T. Leadbetter, Assistant to the Manager, Sales and Installation Engineering Department, Propeller Division, Curtiss-Wright Corporation
Jerome Lederer, Director, Cornell–Guggenheim Aviation Safety Center
Carl W. Lemmerman, President, Industrial Sound Control, Inc.
A. E. Lombard, Jr., Scientific Assistant, Directorate of Research and Development, Deputy Chief of Staff, Development Headquarters, U.S.A.F.
F. A. Louden, Head, Aerodynamics and Hydrodynamics Branch, Bureau of Aeronautics, Department of the Navy
Joseph J. Maitan, Controller, the Institute of the Aeronautical Sciences
Robert J. Mason, Jr., Major, U.S.A.F., Chief Air Tech Liaison Officer, U.S.A.F.
Charles J. McCarthy, Vice-President, United Aircraft Corporation
J. S. McDonnell, President, McDonnell Aircraft Corporation
W. C. Mentzer, United Air Lines, Inc.
William F. Milliken, Jr., Manager, Flight Research, Cornell Aeronautical Laboratory
Glenn Murphy, Professor, Iowa State College
John W. Myers, Vice-President in Charge of Customer Relations, Northrop Aircraft, Inc.
Ralph J. Nunziato, Major, U.S.A.F., Chief, Policy Group Office, DCS/DEV Hdqs., U.S.A.F.
William J. O'Donnell, Chief Development Engineer, Republic Aviation Corporation
John O'Mara, Colonel, U.S.A.F.
Mundy I. Peale, President, Republic Aviation Corporation
Carroll Peirce, Consulting Engineer
Courtland Perkins, Chairman, Department of Aeronautical Engineering, Princeton University
Kendall Perkins, Vice-President, Engineering, McDonnell Aircraft Corporation
George A. Phillips, Application Engineer, General Electric Company
Frank N. Piasecki, Chairman—Board of Directors, Piasecki Helicopter Corporation
Paul A. Pitt, Chief Engineer, Solar Aircraft Company
A. E. Raymond, Vice President—Engineering, Douglas Aircraft Company, Inc.
Arnold H. Redding, Section Engineer, Westinghouse Electric Corporation
James D. Redding, Executive Director, Committee on Aeronautics, Research and Development Board, Department of Defense
Carl E. Reichert, Colonel, Assistant to Chief of Operations, Aircraft Laboratory, U.S.A.F., A.D.F., W.P.A.F.B.
L. B. Richardson, Director of Research and Development, Fairchild Engine and Airplane Corporation
Laurance W. Rockefeller
W. C. Rockefeller, Executive Assistant to the Chairman, Consolidated Vultee Aircraft Corporation
R. W. Rummel, Chief Engineer, Trans World Airlines, Inc.
George S. Schairer, Chief of Technical Staff, Boeing Airplane Company
Edward R. Sharp, Director, Lewis Flight Propulsion Laboratory, N.A.C.A.
D. Roy Shoults, General Electric Company, Lockland, Ohio
Welman A. Shrader, Director of Publications, the Institute of the Aeronautical Sciences
Ferris M. Smith, Vice-President—Engineering, Radioplane Company
R. Dixon Speas, U.S. Representative, A. V. Roe Canada, Ltd.
Kenneth C. Spengler, Executive Secretary, The American Meteorological Society
Elmer A. Sperry, Jr., Treasurer, The Sperry Products, Inc.
John Stack, Assistant Chief of Research, Langley Aeronautical Laboratory, N.A.C.A.
Jackson R. Stalder, Aeronautical Research Scientist, N.A.C.A.
George Starbird, President, Meletron Corporation
H. Guyford Stever, Associate Professor, Aeronautical Engineering, Massachusetts Institute of Technology

(*Continued on page 133*)

Aerodynamic Aspects of the Third International Aeronautical Conference

A. H. FLAX*

Cornell Aeronautical Laboratory, Inc.

THE THIRD INTERNATIONAL AERONAUTICAL CONFERENCE in keeping with the short-standing, but nevertheless firm, tradition established by its two predecessors, effected the exchange of an impressive amount of aeronautical information between the British and American delegates, not merely in the form of technical papers and formal discussions, but also through less formal, but not less effective, channels. The passage through the latter courses was greatly aided and abetted by the happy British custom of "elevenses" in the morning and tea in the afternoon, which provided welcome breaks in the rather formidable program.

Progress was made in overcoming the language barrier between the two countries, this being, in fact, one of the important results of such conferences. Americans were introduced into the mysteries of "cropped," "cranked," and "isoclinic" wings, and the danger that references to such things might be dismissed as some of that obscure British humor, so often alluded to, was greatly reduced. On the other hand, British delegates became aware that "ventilated" tunnels would not necessarily be an improvement on the overheated airless rooms they find so uncomfortable during their visits here and that "blended hulls" were neither a new American fad in baby food nor a new American colloquialism referring to certain types of the human female torso. At the level of finance, it became clear that, as regards the monetary unit employed in allocating funds for new ideas, the "megabuck" came nearer to being a convenient unit than the traditional "fifty pounds," because of technical inflation.

As might be expected in such a conference, the papers covered a considerable area ranging from aircraft materials through structures, aerodynamics, design, hydrodynamics, and propulsion to the problems of aircraft operation. In spite of this wide coverage, almost half of the 20 papers presented could be said to deal with some phase of aerodynamics. The emphasis here was on applied or design aerodynamics rather than fundamentals; but basic theory was not slighted in either the papers or discussions. Aerodynamic considerations pervaded papers on many other subjects to a greater extent than heretofore. Typical of the "new look" was Prof. N. J. Hoff's paper, "Structural Problems of Future Aircraft," which opened with formulas for the drag of supersonic wings and proceeded through many complex structural studies in the midst of which were to be found formulas and data relating to aerodynamic heating.

Considerable comment and some tea-time tempests were generated by the fact that most of the discussion of papers was by British delegates. It appears that a more careful evaluation of the situation would have taken into account the fact that the total British attendance at the conference was understandably some six times the total American attendance; even more significant was the fact that the ratio of British to American attendance by technical and scientific people at the working level was better than twelve to one. In addition, copies of the papers were not received by the American delegates until they arrived at Brighton, at which time they were offered by their gracious British hosts an attractive and comprehensive program that ensured that none need have many idle moments between technical sessions. In view of these factors, the distribution of discussers between British and American does not seem as disparate as it may have appeared at some of the technical sessions when the voice of the chairman was heard in the wilderness crying out for an American discusser. Thus, the reader will understand why most of the comments on discussion in this report on the meeting will necessarily refer to British discussion of the papers.

The aerodynamic side of the conference was opened by T. S. Keeble of the Aeronautical Research Laboratories of Australia, who presented the paper, "The Development in Australia of a Thick Suction Wing."

* Head, Aerodynamic Research Department.

His investigations dealt with a Griffith-type airfoil that was shaped to have a favorable pressure gradient over the forward half and boundary-layer suction at a rearward location on the airfoil. Mr. Keeble's thesis was that, by using this type of airfoil, the drag of thick wings could be reduced to that typical of thin wings. The evaluation of the merits of this scheme was carried out by making design analyses of transport aircraft employing thick suction wings. Although the equivalent wing drag (including the drag equivalent of the pumping power) did not show the startlingly low values usually associated with boundary-layer schemes, a considerable saving in structural weight of the aircraft was estimated, and a corresponding increase in useful load was predicted.

The first tests were carried out on a wind-tunnel model and were occupied with attempts to develop satisfactory slots and airfoil contours in the vicinity of the slots, since the preliminary attempts proved to be unsuccessful. Finally, a three-slot configuration was chosen as a practical optimum. A troop-training glider was next fitted with a suction wing for experiments in flight. Some rather annoying phenomena were discovered in flight. In some cases, laminar separation occurred just ahead of the slots, while in others with ostensibly the same conditions, this did not happen. Sometimes in gusty air at low suction efforts, both régimes of flow were encountered, causing a kind of hysteresis, in that much higher suction was required to attach the flow than to hold it on the surface. It is of interest to note that the total drag of the wing section measured in flight was about 0.007 at $C_L = 0.3$ and 0.019 at $C_L = 1.0$.

Discussion of this paper was considerable and varied. Mr. A. Fage of the National Physical Laboratory expressed the thought that the Griffith-type wing should be applied to large aircraft to obtain optimum results, and he questioned whether application to an aircraft of 70,000 lbs. gross weight would show a sufficient advantage over conventional types. Questions were raised concerning the application of the thick suction wing to a tailless airplane, and it was stated that the other tailless airplanes had had difficulties with low maximum lift and poor directional stability; doubts were expressed as to whether the suction wing would eliminate these problems. Mr. Keeble said that he was fairly certain that they would get a higher maximum lift coefficient and less trouble with tip stalling than had been encountered on the previous flying wing designs. Several discussers pointed out the greater difficulty of maintaining laminar flow up to the suction slot at higher Reynolds Numbers than those that had been used in either the wing-tunnel tests or the glider tests. In particular, Mr. Handel Davies of the Royal Aeronautical Establishment referred to some flight experiments done with a suction wing on a Meteor airplane. They had found that the surface smoothness required at the Reynolds Number of the tests, which was about 15,000,000, was considerably more exacting than that stated by Mr. Keeble. Further, leading-edge contamination was a serious problem.

A second British paper dealing with boundary-layer control was "The Reduction of Drag by Distributed Suction," presented by Sir Melvill Jones and M. R. Head. This paper considered the use of continuously-distributed suction to maintain laminar boundary layer on an airfoil and thereby reduce the profile drag. The tests described were carried out on a two-dimensional wing (this was accomplished by the use of end plates) in free flight. This model wing was carried on an Avro Anson airplane, and suction pumping was accomplished by means of a venturi mounted on the airplane. Some of the conclusions drawn from the experiments as stated by the authors are worth quoting:

(a) On a smooth porous surface of any length over which the pressure and the suction velocity are uniform, laminar flow can be maintained by a suction velocity that is no greater than that required to preserve the stability of the layer and may even be less than this.

(b) If laminar flow is maintained, the velocity profiles of the boundary layer agree well with those predicted theoretically.

(c) These conclusions are not invalidated if the surface has a slight convex curvature or if it is non-porous near the leading edge.

In addition, it was noted that the maintenance of laminar flow was strongly dependent on the smoothness of the surface. In fact, when a small, isolated bump 0.06 in. in diameter and 0.006 in. high was placed on the airfoil surface at about 30 per cent of chord, no suction available would prevent transition. On this basis, it was concluded that to maintain laminar flow, the surface in small area near the front of a body would certainly have to be extremely smooth and free from flies and other obstructions to the flow; further back on the body, however, the surface can probably be appreciably rougher. Velocity profiles measured on the model wing were in good agreement with the theory for flat plates with suction. A typical result was the one for the NACA 64-010 section, which, at a Reynolds Number of 2.64×10^6, with a flow coefficient, C_Q, of 0.00128, gave a total drag (including the equivalent drag corresponding to the pump power) of 0.0021. The paper concluded with some speculations on the ideal laminar flow airplane illustrating the extremely low drags that might be obtained.

The lecture was followed by considerable congratulatory discussion in which it was recalled that several times in the past, Sir Melvill Jones had pointed the way to great advances in the aerodynamic design of aircraft and that he had long held an eminent position in boundary-layer research. Some of the same questions concerning Reynolds Number, the effects of surface smoothness, and their attainment in practical designs which arose in the discussion of Mr. Keeble's paper were again brought up, although the general feeling seemed to be that some of these problems might not be as serious on a wing with continually distributed

suction. There was some concern on the part of the engine people lest it be thought that suction power could be obtained "free" from the turbojet engine. It was also pointed out that a better air frame-engine combination would result if the demands on the engine in respect to boundary-layer suction were considered in advance.

Mr. A. Fage of the National Physical Laboratory presented a review of some of the more recent advances and current research on a wide range of aerodynamic problems. Reference was made to a great deal of work, much of it not published or not available in this country, which should be of considerable interest to American aerodynamicists. "A New Method for Computing Two-Dimensional Compressible Flows Around an Arbitrary Airfoil" by K. W. Mangler was discussed and some results obtained with this method were shown. Also, the results of relaxation-method calculations for compressible flow around an airfoil were shown. Proceeding to wings of finite span, it was evident that a great deal of work was being done on lifting-surface theory, particularly with respect to swept wings. Work on Falkner's vortex lattice theory has been continuing, and a new theory due to Multhopp attacks the continuous lifting surface. The treatment involves methods of approximate integration similar to those used in Multhopp's formulation of lifting-line theory. Additional work has also been done on the modification of the Weissinger theory to deal with difficulties arising from the kink in the center of a swept wing which is reported to exaggerate the variation of the spanwise lift near the central section.

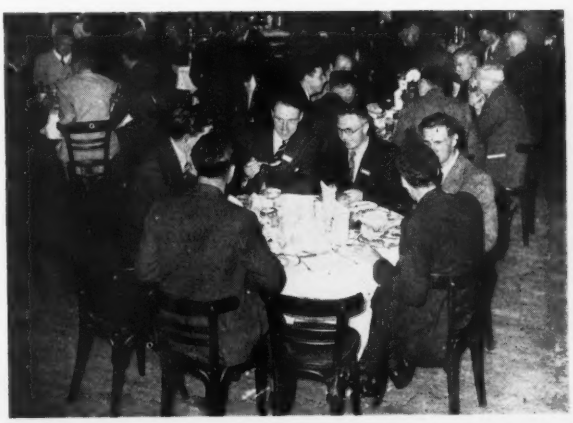
A considerable amount of work on the measurement of aerodynamic forces on airfoils for unsteady flow, particularly in the high Mach Number range, was discussed. The results for the damping in pitch of the two-dimensional airfoil oscillating around 45 per cent of chord for Mach Numbers between 0.2 and 0.7 were presented. The effects of tunnel-wall interference were found to be appreciable, particularly at the low frequencies. Also, marked nonlinear effects were in evidence for this derivative, particularly as the critical Mach Number of the airfoil was approached and exceeded. Two-dimensional measurements of the damping in pitch have also been made in the supersonic range for a 7.5 per cent thick bi-convex airfoil and compared with the results of a second-order theoretical calculation by W. P. Jones and S. Skan; important effects due to thickness of the airfoil were noted in both the theoretical and experimental results. Some measurements of pitching moment damping coefficients for a delta wing of aspect ratio 3 and a swept wing of aspect ratio 6 were also reported and were stated to give rough agreement with a theory by W. P. Jones.

Shock boundary-layer interaction, particularly as encountered as airfoils at high subsonic Mach Numbers, was discussed in some detail, and many experimental results were presented. The problem was shown to be somewhat more complex than has sometimes been imagined, since both normal shocks and branched shocks can occur for laminar as well as for turbulent boundary layer. The lambda or branched shock wave with the main branch inclined upstream was found to occur only for a laminar boundary layer at low Reynolds Number. Also included in the paper were results on viscous effects in supersonic flow around two- and three-dimensional airfoils, boundary layer at high Mach Numbers, work with boundary-layer suction, particularly the Griffith-type and Thwaites-type airfoils, and air intakes.

In the discussion, Mr. Fage was congratulated for having covered so wide a range of subjects so concisely and clearly. There were multitudinous questions as to the details of the wealth of theoretical and experimental data to which he had referred, and, naturally, there was not sufficient time to go into such detail. The methods used to calculate viscous effects on airfoils came in for considerable attention, and it was obvious that this was a live subject. The forthcoming papers referred to in Mr. Fage's paper will be awaited with interest.

W. F. Milliken, Jr., of the Cornell Aeronautical Laboratory, Inc., presented a comprehensive paper entitled "Stability and Control Research" in which he reviewed the status of investigations and problems in this field. Of considerable interest were the many experimental results on the dynamic response of full-scale aircraft in both the longitudinal and lateral modes of motion measured in flight. Evaluation of various methods of extracting aerodynamic derivatives from these measured responses was presented, and comparisons of experimental and calculated results were shown. Of particular interest to the aerodynamicist is the confirmation of the basic assumption of stability theory, on the basis of both theory and experiment, that at the reduced frequencies corresponding to the stability range of aircraft, nonstationary flow effects other than those associated with downwash lag are of secondary importance, except possibly in the transonic range. The problems involved in the extension of these measuring techniques to the transonic

Daily luncheons held in the Corn Exchange gave British and American Delegates an opportunity to discuss further the papers presented at the technical sessions.



range were discussed at some length, and the possible effects of nonlinearity or additional nonstationary effects were treated. The thesis was advanced that greater attention should be given both in research and in service aircraft to the use of servomechanisms to provide artificial dynamic stability where the aerodynamic stability was found wanting. The application of such techniques to the control of stalled aircraft was discussed and illustrated in an impressive motion picture showing the Fairchild PT-26 airplane employing artificial stability in stalled flight. It was argued that the phugoid and spiral modes that are currently in disregard as important factors in the handling qualities of aircraft should be reconsidered. Application of dynamic techniques along with statistical analysis to gust research was discussed, and it was stated that such research should be of value not only for structural reasons and for gust alleviator design, but also in respect to missile control systems.

In the discussion, there was rather general agreement as to the importance of continued basic research utilizing dynamic response techniques. There also was evidence of some reluctance on the part of British aerodynamicists to turn over the problem of aircraft stability to servomechanisms; there appeared to be the general feeling that some basic minimum aerodynamic stability would still always be required. The suggestion that the phugoid and spiral modes should receive greater attention was also the subject of some skepticism. There was, however, a general feeling that the increased emphasis on dynamic considerations in airplane characteristics would continue, and, in particular, the question of gust research was of considerable interest.

The paper, "Some Research on High-Speed Flutter," by I. E. Garrick was a survey of the extensive recent activities of the National Advisory Committee for Aeronautics in this field. Although a considerable part of the paper dealt with the overall flutter problem involving the structural and inertia factors as well as aerodynamics, there were a number of items of aerodynamic interest in this paper. Of particular interest were some calculations by C. Watkins on the regions of negative damping in pitch for delta wings oscillating about a spanwise axis. It was found that for sweep angles in excess of 45°, the range of Mach Numbers for instability rapidly decreased with sweep angle. It was pointed out that thickness effects might have a marked influence on these results. Another interesting result that was brought out in respect to wind-tunnel testing of oscillating wings was obtained by H. L. Runyan. This is based on a consideration of acoustic organ-pipe resonance effects in the tunnel which may have the effect of making the tunnel wall corrections large. The analysis was made for an oscillating two-dimensional airfoil in the two-dimensional tunnel, and the phenomenon was shown to be dependent upon a critical relationship between the frequency tunnel dimension and Mach Number.

Because of the current interest in England in delta-wing aircraft, the results given for the damping in pitch of such wings received considerable discussion, and all agreed that the results quoted in the paper based on the linearized theory should receive early experimental check.

H. R. Lawrence and this writer presented a paper, "The Aerodynamics of Low-Aspect-Ratio Wings and Wing-Body Combinations," which considered the problem of determining aerodynamic characteristics for low-aspect-ratio (less than 3) wings. Since the curves for lift and pitching moment for such wings show appreciable non-linear variation with angle of attack, it was argued that something outside the scope of linear lifting-surface theory was required. It was shown, however, that the predictions of linear theory were in good agreement with experiment at small angles of attack. Therefore, the problem was divided into two parts: (1) to investigate suitable approximations to linear lifting-surface theory for low-aspect-ratio wings and (2) to devise some means for evaluating the nonlinear terms. The general nature of approximations to lifting-surface theory was considered for both high- and low-aspect-ratio wings, and a suitable approximation for a certain class of low-aspect-ratio wings due to Lawrence was presented. Comparison of the lift, moment, and pressure distribution according to this theory with experimental results for rectangular and delta wings at extremely low angles showed satisfactory agreement.

The nonlinear effects on lift and moment were described in some detail, based on existing experimental data. It was proposed that the major part of these nonlinear effects could be accounted for by adding to the linear theory the effects of viscous cross flow in planes transverse to the longitudinal axis of the wing. Comparison of results calculated in this way for lift and moment with experiments on rectangular, delta, and trapezoidal wings having various cross-sectional shapes showed good agreement. An approximate method of extending the analysis to wing-body configurations was presented.

Professor J. Ackeret of the Technische Hochschule, Zurich, opened the discussion, stating that, while he felt the treatment of linear effects was satisfactory, the analysis of nonlinear effects was too reminiscent of hydraulics to be acceptable. Further, he showed results on slender bodies of revolution on which the pressures on the upper surface were in good agreement with potential flow theory for all except a small region at the back end so that the addition of a cross-flow drag term could not be justified in general. The British discussers questioned the range of validity of the nonlinear theory, particularly as regards the wing-body problem, but agreed that the general idea of the nonlinear analysis would be useful in dealing with low-aspect-ratio wings. Some of the partisans for swept wings as against delta wings advanced the thought that some of the difficulties of analysis discussed in the paper and, in particular, the nonlinearities constituted

further reasons why the delta wings should not be used on high-speed aircraft. The partisans for delta wings felt that the paper presented the qualities of delta wings in too unfavorable a light, since full-scale flight experience showed the flying qualities to be satisfactory.

The paper, "Performance Characteristics of Jet Nozzles," by G. S. Schairer, Boeing Airplane Company, treated some of the problems of the application of jet nozzles to aircraft, touching on a number of incompletely explored regions of the problem. The extent to which one-dimensional theory could be used to predict the behavior of nozzles of practical construction was investigated for both converging and diverging nozzles. Convergent nozzles of various cross-sectional shapes and various contraction rates were tested, and, in general, good agreement with one-dimensional theory was found. On the other hand, the performance of expanding nozzles, which would be useful for the higher pressure ratios, could not be predicted by any presently known method. It was found that their behavior at low-pressure ratios (overexpanded) was poor, but actually, the experimental results showed better performance than estimated. The conclusion was reached that convergent nozzles represented a practical optimum for most uses at pressure ratios less than 4.

A number of methods for achieving practical variable area convergent nozzles were looked into. Simple tabs and plugs at the exit were found to be capable of giving good results, but, depending on details of the design, poor performance could also be encountered. Double nozzles in tandem were investigated with a view toward submerging the primary jet nozzle inside a shroud so that the more direct effects of nozzle parameters on external aerodynamics would be minimized. Considerable difficulties and, in general, poor performance were found in limited tests of such nozzles. With regard to the external flow around the nozzles, it was found that for low flow rates through the nozzle, the drag was high but that this rapidly decreased to a constant low value as flow started through the nozzles. Appropriately shaped nozzles could be made to have a high critical Mach Number, but poor critical Mach Numbers were found for many of the commonly used shapes.

The discussers agreed that more work was needed on the many problems that had arisen in connection with jet nozzles, and the feeling was that this paper had done a good job of pointing the way.

With interest still at a high peak, the conference closed with the paper, "Experimental Methods for Transonic Research," by J. Stack, National Advisory Committee for Aeronautics, which surveyed the impressive volume of work in this field carried out by the N.A.C.A. It was pointed out that, since conventional high-speed wind tunnels are limited by choking to operation below a Mach Number of unity and since operation near choking involves questionable test conditions, experimental research in this field involves considerable fundamental difficulties. For this reason, a comprehensive and many-sided attack on the problem was employed.

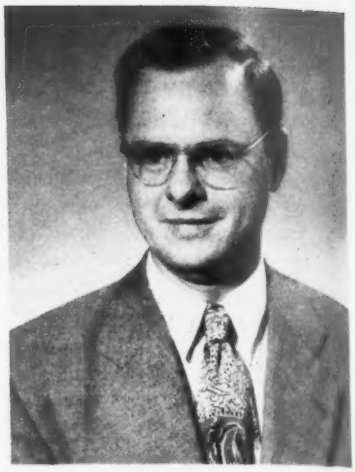
Because of the choking phenomenon, free-flight test vehicles were often resorted to. Among these were: free-fall and rocket-powered flight models in combination with telemetering, radar, and optical tracking; high-speed airplanes employing the "wing-flow" technique to test small models mounted on their wing upper surfaces; and finally, research airplanes specially designed to fly through the transonic range. All of these methods were stated to be successful, at least for some types of tests, but the results, especially those from the research airplanes, were heavily shrouded in security restrictions.

Despite the success of the free-flight techniques, the desirability and usefulness of laboratory facilities for transonic testing were obvious, and efforts to develop such facilities were being continued. The wind-tunnel "bump" technique, analogous to the "wing-flow" technique in flight, provided such a laboratory facility in a limited sense, being, of course, subject to severe limitations in respect to flow-field uniformity and Reynolds Number. Two new transonic wind-tunnel facilities were developed to attempt to improve the situation. One was the annular flow tunnel, in which the airfoil under test is placed at the tip of a high-speed rotor that is mounted in a tunnel of relatively low axial speed; the test section is a thin annulus in which the model moves as it rotates. Test Mach Numbers of unity and above have been obtained in this facility. The second type of wind-tunnel facility developed was the "half-open" tunnel; this was a rectangular tunnel with floor and ceiling removed. With this tunnel, the subsonic choked range was greatly reduced, and a Mach Number of unity could be approached.

Perhaps the most dramatic moment of the conference, at least from the aerodynamic standpoint, came when, at the conclusion of the presentation of the written paper, Mr. Stack announced in a guarded way that a method of "ventilating" a wind-tunnel test section had been found which would permit testing in the transonic range continuously through a Mach Number of unity (a similar announcement appears to have been made publicly in the U.S. several weeks before). No further details could be given because of security restrictions.

The discussion of this paper included much congratulation of the speaker for his presentation of work that was so obviously a contribution to the meager existing knowledge of experimental aerodynamics in the transonic range. Unfortunately, security restrictions on both the U.S. and British delegates prevented an open discussion of most of the points raised by the paper.

Review of Papers on Air Transport



R. W. RUMMEL*
Trans World Airlines, Inc.

THE LEAD HELD BY THE BRITISH in the development and production of commercial turbine-powered aircraft is permitting the attainment of leadership in air-line operation with this type of aircraft as well. B.O.A.C. is currently conducting extensive proving trials with the de Havilland Ghost powered Comet from London to Middle East terminals. It is anticipated that scheduled passenger service will be undertaken with this type of aircraft in the near future. Also, as elaborated on by K. G. Wilkinson of the Project and Development Branch of British European Airways Corporation, B.E.A. operated a Rolls-Royce Dart powered Viscount in scheduled London–Paris and London–Edinburgh service last summer for 138 hours. This is preceded with 132 simulated service hours.

These operations have permitted attaining direct knowledge of problems of dispatching and flight control peculiar to turbine-powered aircraft operation, including holding, limitations of existing radio facilities, etc. Accumulation of such firsthand knowledge will unquestionably tend toward still further improvements in the art of building commercial turbine-powered aircraft in England and tend to increase their lead over this country.

Mr. Wilkinson pointed out in his paper entitled "Some Problems of Turbine Transport Operation in Europe" that the Viscount was remarkably trouble-free, encountering only six minor defects that caused unscheduled maintenance work. He estimated that not less than 20 such occurrences would have been experienced had the airplane been equipped with piston engines.

B.E.A. considers normal flight-control procedures extravagant for turboprop type aircraft. They found London radar particularly beneficial, both inbound and outbound, to provide distance checks from beacons and reporting points. Such check points are of particular importance to govern speed and rate of climb and descent. B.E.A. has found that radio beacons will not be much help in cruising at 30,000 ft. and above.

Ability to control rate of descent over a wide range at the same forward speed is, Mr. Wilkinson believes, invaluable to the operation of turbine-powered aircraft. Also, ability to hold in the stack with one or two engines cut would be a great help when encountering abnormally long delays. Such an operation was considered entirely satisfactory on the Viscount except in icing conditions. He recommended that high-level holding be accomplished with four engines operating and that two-engine low-level holding be considered a permissible emergency procedure.

B.E.A.'s operations have emphasized the need for "accurate flying and navigation and precise cruising control even on relatively short flights." Crews should be able to handle diversion or stacking to the best advantage in a wide variety of conditions. It should be possible for them to decide at any moment what courses are open with a given quantity of fuel in the tanks. All this may indicate the need for flight engineer's stations in all turboprop- or turbojet-powered commercial aircraft.

Mr. Wilkinson also proposed the statistical probability approach to enable carrying less fuel reserve and greater pay load. He terms this the "Variable Booking Payload" method. It is designed to permit last minute release of seats for sale.

Mr. Wilkinson considers the most important developments in turbine transports in England in the near future to be likely in the field of operational techniques.

Mr. T. S. Keeble, Principal Scientific Officer, Aeronautical Research Laboratories, Commonwealth of Australia, presented a paper entitled "Development in Australia of a Thick Suction Wing." Mr. Keeble describes the wind-tunnel development of the airfoil, related boundary-layer study, the test glider, and its flight test. The glider is a DHG2 modified to incorporate a 48-ft. 9-in. span wing of 96 in. maximum cord and 31 in. maximum depth. Wing suction is provided by a power-driven blower mounted in the fuselage. He reports the glider could be flown with suction on or off sufficiently well for an experienced pilot to make safe

* Chief Engineer.

approaches and landings. The only unexpected behavior was with insufficient suction. This resulted in lateral instability that could cause loss of aircraft control if too much skid was allowed to develop. Also, with low airfoil suction, surface imperfections that prevent flow from sticking steadily and rough air resulted in questionable handling characteristics. He reported that the glider handled well with flow properly stabilized and that poor handling characteristics could be improved by using full suction or by turning the suction off entirely.

Mr. Keeble briefly discusses the preliminary design of an all-wing air liner with a span of 100 ft. This ship would be powered with two 2,900 hp. gas turbine engines and one additional 1,500 hp. engine for suction. Alternate suction would be provided by the two main power plants. He compares such an aircraft to the Douglas DC-4 and estimates that it would, at the same total thrust, cruise 40 per cent faster and carry 40 per cent greater pay load. Such an aircraft would, of course, if successfully developed, be of major interest to air-line operators because of the obvious economy that would result. Mr. Keeble proposes a new test glider with the same plan form as the proposed air liner for purposes of further experiments.

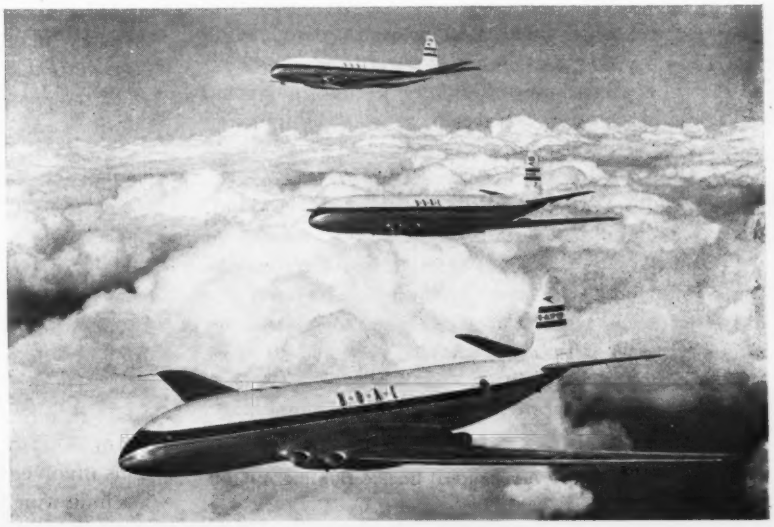
Mr. B. S. Shenstone, Chief Engineer, British European Airways, presented a paper entitled "Engineering Problems of Aircraft Operations." This paper is an outline of maintenance, overhaul, purchasing, and engineering functions of B.E.A., all of which are combined under the engineering function in that air line.

He suggested that shop-originated airplane modifications be accomplished by the shop rather than through usual engineering and production control channels. He feels that such an approach would minimize overhead and permit practical resolution of problems confronting shop personnel.

He also indicated that air lines "should never get involved in aircraft design." The premise that the airplane manufacturer must be responsible for the design of his product is well recognized and established on both sides of the Atlantic. In the United States, however, it is frequent indeed that air lines must get involved in aircraft designs to the extent of establishing design criteria that suitably reflect operating experience. This frequently applies not only to system details but to more major concepts as well. In this sense, the air lines do participate in determining what the airplane design will be, but only the airplane manufacturer can be considered responsible for the design, since it is under his direct control and since he must make design decisions and integrate various aspects of the design into the complete working unit. Mr. Shenstone points out the disappointing frequency of cases where lack of maintenance information in the hands of designers to correct faulty designs has existed when such defects could easily have been corrected in the drawing board stage.

With respect to overhaul bases, Mr. Shenstone recommended one rather than multiple bases where route structure permits. The new B.E.A. base at Northholt is arranged so that complete maintenance and overhaul is accomplished on each aircraft with the aircraft remaining in one position. This is presently current practice in the States. B.E.A. does not schedule major airplane overhauls but accomplishes work in cycles of the basic overhaul figure, which presently is 1,000 hours for the Viking and 800 hours for the Dakota. The worst problem, Mr. Shenstone reports, is the unserviceable items causing delays in departure.

The lead the British have taken in the development of turbojet and turboprop commercial type aircraft is indeed impressive. It is a lead that does exist and which probably will be maintained for a considerable number of years. Current estimates are that the earliest that turbine-powered commercial aircraft would be suitable for operation in the States would be in the order of 1956, whereas B.O.A.C. expects to operate Comets in commercial passenger operations in 1952 and B.E.A. expects to operate the Viscount turboprop commercially by late 1953 or early 1954.



Three jet de Havilland Comets flying in close formation over Hatfield during proving trials in anticipation of introduction into regular B.O.A.C. service early in 1952.

A Review of Papers on Structures and Materials

NICHOLAS J. HOFF*
Polytechnic Institute of Brooklyn

Introduction

Five out of 20 papers presented at the Third Anglo-American Aeronautical Conference in Brighton dealt with structures and materials. Of the five, four were given by British authors and one by an American. An analysis of the titles of the papers and their contents discloses that, in general, British structural designers worry about problems similar to those that trouble their American counterparts. For example, the stresses in the root section of highly swept wings present an immediate problem to the structural analyst on both sides of the Atlantic.

There are some differences in emphasis which are worth mentioning. Problems associated with high temperatures caused by aerodynamic heating have not commanded the attention of the designers in Great Britain to the same extent as in the United States. This is perhaps a consequence of the shorter period of time during which guided missiles have been developed in Great Britain. It does not mean, however, that the British consider guided missiles less important. Some British airplane designers feel that missiles are the natural weapon for the United Kingdom in the defense of their islands.

Greater interest is shown in England in the development of fiber-reinforced plastics for the principal structural elements of aircraft than in the United States. Of course, the British did not go through the cycle of overenthusiastic publicity for the molded airplane and the letdown that followed it which did so much harm to the idea of the nonmetallic airplane in the United States. The bonding of metal to metal by means of synthetic resins has made further strides in England and is now being used at least by two leading airplane manufacturers on production type planes.

With this general introduction, the five individual papers will be reviewed concisely in the order in which they were presented at the meeting.

Advances in Aircraft Structural Design, by G. T. R. Hill, Consulting Engineer, Short Bros. and Harland, Ltd.

It was most appropriate that the conference was opened with a talk given by a man who was already a successful designer in the twenties. At that time, Professor Hill attracted attention with his series of tailless airplanes named Pterodactyl. His lecture surveyed the outstanding structural problems that

faced the aeronautical engineer in the past, and he made some guesses as to developments in the future.

In Professor Hill's opinion, the once mysterious downward failures of monoplane wings were caused by what is now known to the aeroelastician as divergence. In general, the antilift wires were arranged at extremely small angles and permitted a considerable twisting of the torsionally weak wings when the center of pressure of the highly cambered surfaces traveled toward the trailing edge. The first failure of an airplane because of divergence was that of Langley's tandem monoplane.

Professor Hill feels that structural designers have done a good job in the last 30 years. They have been successful in decreasing the percentage of structural weight considerably. A further step in this direction will be the general acceptance of gust alleviators. This is important because modern transport planes are designed almost entirely on the basis of gust requirements. The opposition to these devices might be overcome more easily if a less clumsy name could be found for them.

The once separate fields of aerodynamics and structures have been merging in investigations of aeroelasticity. In Professor Hill's memory, the earliest case of flutter occurred on the Handley-Page 0/400. The torsional oscillations of the fuselage were coupled with antisymmetric elevator rotations. The established methods of aeroelastic analysis have to be modified for highly swept- and delta wings in which structural bending and twisting are interconnected with changes in incidence in a rather complex manner. This involved relationship is unscrambled in the aeroisoclinic wing advocated by Professor Hill.

* Head, Department of Aeronautical Engineering and Applied Mechanics.

In his conclusion, Professor Hill gave expression to his belief that advances in engineering can be made only through the proper combination of systematic research with bursts of inventive development. He regretted that the latter have become all too rare.

In the discussion of the paper, Mr. S. Scott Hall, Director General of Technical Development (Air) in the Ministry of Supply, protested against the claim of all inventors for public funds to develop their ideas. One of the most important ideas that has emerged during the last decade is that development has to be planned. It is the duty of the Ministry of Supply to channel government money in the most promising directions. Inventors do not realize that support of their ideas retards the development in other directions that might be more important to the country as a whole.

Structural Problems of Future Aircraft, by N. J. Hoff, Head, Department of Aeronautical Engineering and Applied Mechanics, Polytechnic Institute of Brooklyn.

The paper begins with the discussion of the reasons why new structural design methods have been introduced for high subsonic and supersonic aircraft. The sandwich skin, the honeycomb core, integral stiffener construction, and corrugated sheet construction are described. The problem of supersonic wing construction has two main aspects. First, the wing has to be extremely thin, since its drag increases with the square of the thickness. Second, the surface of an airplane flying at supersonic speeds is heated to elevated temperatures. It is estimated that steady-state temperatures of 600° to 1,000°F. are likely to occur in the near future and 2,000°F. or even 3,000°F. are possible later if the structural and material problems can be solved.

A distinction should be made between transient and steady-state thermal conditions. If the guided missile flies only for a few minutes, the surface of the wing is heated to a high temperature, and the internal structure remains comparatively cold. The thermal gradients cause internal stresses as a consequence of the nonuniform expansion of the material. In the shear web of a wing flying at a Mach Number of 3.1, calculations give a maximum stress exceeding the yield point of the material. In the steady-state condition, the effect of creep must be taken into account. An analysis has shown that a column having a slight initial curvature buckles under the slightest compressive load if the load acts upon it for a sufficiently long time. This means that supersonic aircraft will have to be designed for a definite lifetime and not to last forever.

A favorable time effect can be mentioned in connection with columns upon which compressive loads act only for a short period. Such a column does not have enough time to buckle, and thus it can carry loads exceeding the Euler load. It was calculated that the load carrying capacity of a slender and carefully manufactured column is increased 38 per cent above the Euler load when the maximum load is reached in 0.01 sec.

The paper closes by suggesting three classes of aircraft for airworthiness calculations: (1) Not expendable aircraft, such as the subsonic transports and private planes of today. (2) Semiexpendable aircraft. In this class fall the piloted supersonic fighters whose structural integrity must be maintained for something like 100 hours. (3) Expendable aircraft. Guided missiles that have to last only for a few minutes can be included in this class.

In the discussion, Dr. A. E. Lombard, Jr. (Scientific Assistant, Directorate of Research and Development, Deputy Chief of Staff, Development, U.S.A.F.) suggested that the structures man of the future should be called a "thermoelastician." This suggestion was topped by A. H. Flax (Head, Aerodynamics Research Department, Cornell Aeronautical Laboratory) by introducing the new designation "aero-thermo-elastician."

Plastics and Plastic Structures, by J. E. Gordon, Chemistry Department, Royal Aircraft Establishment.

The main thesis of Mr. Gordon's paper is that the suitability of plastics for aircraft construction can be judged only on the basis of complete aircraft, or at least complete aircraft wings or fuselages and not from tests carried out with small elements such as compression panels. For this reason, the Royal Aircraft Establishment initiated a program in which new materials, new manufacturing methods, and new types of aircraft structures have been developed simultaneously. A straightforward replacement of metal aircraft elements by plastics must be unsuccessful, particularly because such a plastic structure will not be sufficiently rigid.

The two main components of the plastic structure are the fibers and the synthetic resin. The fibers are extremely strong in tension. Their rigidity is also high, Young's modulus for chrysotile asbestos being equal to that of steel and Young's modulus of glass fiber equaling approximately that of aluminum alloys. Of the two kinds of modern synthetic resins used in airplane structures, the British prefer phenolics to polyesters. In the tests carried out at the Royal Aircraft Establishment, Durestos was used. It is a felt of asbestos fibers held together by a phenolic resin. At a specific gravity of 1.27, the ultimate tensile strength of this material is 20,000 lbs. per sq.in., and Young's modulus in tension 2.4×10^6 lbs. per sq.in.

Design, construction, and tests have been completed on a nontapered straight wing whose structure is essentially a shell having the shape of the wing contour and closed aft by a channel-shaped web. The compression side is stiffened by a molded-in compression boom, and the interior of the wing is filled up almost completely with a paper honeycomb. The shearing rigidity of the wing is increased by the insertion of a number of thin plywood ribs. The wing was found to be stronger and stiffer than the metal wing

designed and constructed at the same time to the same specification.

Development work is now in progress on a delta wing of a plastic design to replace the original metal wing of a small fighter plane. It is believed that the plastic wing will be lighter than the metal wing for equal strength and stiffness.

It was brought out in the discussion that, at the present stage of development, the success of the plastic wing depended greatly on the ingenuity of the designer. W. B. Bergen (Vice-President–Chief Engineer, The Glenn L. Martin Company) gave some information on the autoclave-bonded aluminum honeycomb core type of sandwich now used extensively by his company in guided missile construction. The company is planning to incorporate the same design in piloted aircraft.

The Experimental Study of the Static Stiffness and Deformation of Swept Wings with Uniform Chord, by A. H. Hall, Structures Laboratory, National Research Council, Canada.

The paper is a detailed description of test results obtained with a series of carefully manufactured cellulose acetate models of swept wings subjected to wing tip torque and to shear forces. One purpose of the investigation was the establishment of angle of twist and deflection data as functions of the sweep angle. The second purpose was to evaluate the relative merits of wing ribs arranged perpendicular to the leading edge and parallel to the direction of flow, respectively.

Altogether eleven models were constructed and tested with sweep angles varying from $-15°$ to $+60°$ in $15°$ increments. The length of the chord of all the models was 16 in. when measured perpendicular to the leading edge. The chord length was constant, and the wing section had a maximum thickness of 20 per cent at 40 per cent of the chord.

Detailed results of the experimental investigation are presented in a number of diagrams. A general conclusion derived from the charts is that the direction of the ribs has little effect upon the deformation of the wings.

The discussion brought out the difference between the standards of the practical stress analyst and the academic research man. To the latter, the stresses in swept wings do not present an exciting problem, because they can be defined by writing down perhaps 100 simultaneous linear equations. The practical stress man is vitally interested in any improvements in technique, because he has to solve all these equations in order to get numerical values for the stresses.

Some Material Problems of High-Altitude Aircraft, by H. W. Hall, Head, Plastics Section, Chemistry Department, Royal Aircraft Establishment, and T. P. Hughes, formerly Chemistry Department, now Chief Superintendent, Rocket Propulsion Department, Royal Aircraft Establishment.

The authors discussed the properties of the nonmetallic materials used in high-speed high-altitude aircraft. In particular, they described the problems encountered in fuel systems and gave a detailed analysis of the crazing of high polymers.

It was pointed out that the materials expert has to count upon the possibility that an aircraft may take off from the ground at a temperature of more than $100°$F. in the tropics and end up after a few minutes' flight at an altitude of 40,000 ft. at a temperature of less than $-90°$F. Such a rapid change in temperature and the consequent steep temperature gradients lead to all sorts of trouble.

One is the vapor lock encountered in the fuel pumps of aircraft. It is likely to occur when the vapor pressure in the fuel system decreases sufficiently to cause boiling. Another bad effect of boiling is the loss of gasoline. Remedies are the cooling and pressurization of the fuel tank. Kerosene is not likely to cause trouble below an elevation of 60,000 ft. However, its availability in Great Britain is poor, and, for this reason, even turbine engines have to operate with gasoline.

A detailed investigation of the crazing of transparent plastics has been carried out at the R.A.E. Crazing is the appearance of scratches on the surface of a plastic. The scratches were found to be the consequence of local tensile failures near the surface.

Crazing occurs only if the temperature is so low that the polymer is brittle. Moreover, its development depends upon the simultaneous presence of tensile stress and solvent. In the "as cast" condition, residual acrylic monomers are always present and constitute a solvent of the polymer. At the same time, frozen-in stresses provide the other condition for crazing. Heat treatment removes solvent and residual stresses to a large extent, and thus crazing is less likely to occur in hot-formed sheets.

The region where crazing usually begins in canopies is the neighborhood of the holes drilled along the edge. Glass fiber reinforcements along this edge have given good results. The explosive failure of the canopy initiated at some point away from the edge has been eliminated by the use of sandwich construction incorporating a tough and rubbery middle layer.

The sensitivity of plastics to details of the manufacturing process was illustrated in the discussion by Lysle A. Wood, Chief Engineer, Boeing Airplane Company. G. R. Edwards, Chief Designer, Vickers-Armstrong, Ltd., pointed out that far too little emphasis has been placed on the development of nonmetallic materials for aircraft construction. The difficulties discussed in the paper by the authors were known to exist 10 years ago. Nevertheless, funds have not been made available for their investigation to an extent commensurate with their importance to aviation.

Some Observations on Aeronautical Research in England with Particular Reference to Stability and Control

WILLIAM F. MILLIKEN, JR.*
Cornell Aeronautical Laboratory, Inc.

WHILE IT IS MANIFESTLY IMPOSSIBLE for one individual to draw unqualified conclusions from a fortnight's visit to the British aeronautical research scene, it is perhaps permissible to record impressions and observations incomplete though they may be.

With the exception of the extreme cordiality shown to the Americans and the excellence of Captain Pritchard's conference organization—both of which must come first in any appraisal of the visit—the writer's strongest impressions relate to two general characteristics of British research operations which apparently differ in philosophy from our own. In the first place, the average British research worker, by comparison to his American counterpart, is more aware of ambient limitations in man power and financial resources, and the desirability of obtaining the maximum utility from a given amount of effort. It appears that considerable care and thought are expended in the most logical allocations of these basic resources, in arriving at decisions as to desirable fields to exploit, and in the avoidance of duplication. As a result, it is a reasonable certainty that, whenever a visitor finds an appreciable volume of work in progress upon a particular subject, he may be assured that the program under consideration is one of significance, at least to the British mind. In addition, if several projects of a related nature are under way, it is a good bet that the subject has assumed a first-order priority to the British research "powers-that-be." This care in choosing research is thoroughly commendable and, as all the world knows, has resulted in many British "firsts," for a surprisingly small total outlay.

Before applying the above criterion to stability and control research, it may be well to mention the second generality, which again, in part, arises from the economic situation but is also a reflection of a characteristically conservative and cautious outlook. This is the matter of publication of progress reports and exploitation of ideas in the formative stages. If the Americans overdo the publication of undigested research material, the British lean equally heavily in the opposite direction and seem to prefer to disseminate information only when it has been thoroughly evaluated by themselves and judged to be good. Regardless of the correctness of this policy, it does mean that the most practical way of "getting-up-to-date" on their research in a particular field is to go there directly and converse with the active research people themselves. Certainly, it is

the writer's impression that this is more nearly a necessity than in our country; though it must be admitted that the short distances inherent in the British Isles make extensive personal contact between research and industry entirely feasible.

Relative to developments in the stability and control field, this writer was prone to look for research that would supplement, or cover, some of the noteworthy gaps in our own efforts. In this search I was by no means disappointed.

As is well known, the industry in the United States is currently plagued with an inordinate share of stability and control design problems that have arisen from the rapid increases in performance into the trans- and supersonic régimes, from the unorthodox configurations of airplanes and missiles which have accompanied this trend, and finally from the general tightening up of flying qualities requirements necessitated by the military demands for more precise combat maneuvering. The difficulty, if not impossibility, of meeting these demands with fixed aerodynamic configurations and unassisted human pilots is leading to a greatly increased use of all types of automatic control, artificial stability and stabilizing systems—in short, the integration of servomechanisms into our overall design thinking—which, in turn, has given rise to the enhanced use of complete dynamic analysis. While, to quote one English scientist, "the cybernetics revolution has yet to sweep England with full intensity," the writer was nevertheless anxious to obtain a forecast of British reactions to the more wholesaled use of servomechanisms.

* Manager, Flight Research Department.

It would appear, from the writer's brief observations, that the average British design team will fight just a little harder to do the job with conventional aerodynamics than the corresponding American organization. The attitude may be summed up by the direct quote, "While we are well aware of the inevitability of placing more of the control and intelligence functions upon the automatic, we believe that the best policy is to forestall this ultimate trend by placing as much resistance as possible in its path." On the other hand, in strictly research circles, the British are following a course of preparedness and are laying considerable stress on basic dynamic developments, along with such practical applications as rate dampers, which they and the Germans pioneered. This research may be associated with the emphasis being laid upon flying wing development of the delta type, for, in connection with this class of aircraft, it should pay off heavily. The Americans were generally impressed by the array of four research aircraft of this type—the Avro 707, 707A, the Boulton Paul P.111, and the Fairey FE.1—but at the same time were frankly skeptical. As Professor Perkins (of Princeton University) so aptly pointed out, American experience with flying wings (a large part of which has admittedly been with higher aspect ratios) has hardly been reassuring from the flying qualities standpoint. As the British push their research aircraft into the trans- and supersonic régimes, they may find it absolutely requisite to turn to servomechanisms for assisting the best aerodynamic design compromises. It seems patent, even at this stage, that British experience, as well as our own, predicts an intimate association of artificial stabilization and tailless aircraft.

In the entire matter of rationally applying dynamic analysis in design, there continue to exist two important "bugaboos"—namely, (1) the lack of numerical data on the aerodynamic parameters during the design stages and (2) the inherent drudgery and little physical feel associated with conventional dynamic calculations.

It has been the writer's contention for some years that the real answer to the first item lies in the development of methods for the routine testing of nondynamically similar models of good size in conventional wind tunnels, these tests to undergo proper initial correlation with the results of full-scale measurements of the type developed at Cornell Aeronautical Laboratory, Inc. By way of soliciting reaction from the British, a sizable section of the author's conference paper* dealt with this matter, stressing the logical attack of forced oscillation testing as a means of obtaining the derivatives, with a résumé of associated work currently in progress in the United States. It was extremely refreshing to find that the British are making a concerted attack on this problem, of a magnitude that not only indicates their belief in the importance of the work but which has already begun to pay off in worth-while results. Though a detailed résumé is impossible, it can be stated that none of the possible schemes for oscillating models in the wind tunnel has been overlooked nor is their research limited to stability frequency ranges. The difficult problem of providing inertia balance—so that the small oscillating aerodynamic moments may be accurately extracted—has received due attention, and several worthy schemes have been proposed and proved, The British are to be congratulated on their general progress in this area, which, it is hoped, will stimulate American research circles to "get going" on this sadly neglected subject and expedite such work as is already under way.

Until the aircraft designer can call for, and obtain, in routine fashion, any or all of the dynamic stability and control derivatives from the wind tunnel, we are in a vulnerable position with regard to the increasingly complex dynamic problems that are already appearing over the horizon. Development of methods of wind-tunnel measurements for dynamics is the critical need in the stability and control field. In particular, we must establish the linearity or nonlinearity of the various derivatives in the transonic, the significance of the oscillating airfoil effects on stability by experiment, and obtain a more detailed knowledge of the downwash derivatives. The announcement by John Stack, in his paper at the Conference, that transonic wind-tunnel testing is now an established fact only serves to increase the urgency for devising more adequate dynamic model test procedures. (Reference should be made to the paper by Fage for some results from oscillation tests for the damping in pitch derivative.)

On the subject of new dynamic analysis methods of less drudgery and more physical insight, it can only be said that here the British are making substantial progress with a vectorial scheme that fits midway between the hand solution of the differential equations of motion and the conventional electronic analog computer. Dissemination of this new work appears to be a matter of some urgency, since it is likely to find many new uses. It is possible, for example, that it might be adaptable to the extraction of the derivatives from flight-test response measurements.

There are three important areas in stability and control research in which the British are performing little work—namely, (1) full-scaled dynamic response measurements, (2) use of artificial stability as a tool for the determination of rational flying qualities specifications, and (3) the study of gust fields and gust responses by means of the statistical concepts of "noise" theory.

The lack of activity in the first of these seems to arise largely from economic reasons and not for lack of interest or appreciation in the importance of these measurements. At both the Royal Aeronautical Establishment and the National Physics Laboratory, there seemed a genuine interest in the progress that has been made in this full-scale research in the United States. The need for this information in design circles

(*Continued on page 82*)

* *Dynamic Stability and Control Research*, Anglo-American Aeronautical Conference, 1951.

Comparisons of British and American Gas-Turbine Practice

E. S. THOMPSON*
AND
N. BURGESS†
General Electric Company

AIRCRAFT GAS-TURBINE DESIGNERS in attendance at the Third Anglo-American Conference at Brighton could not fail to be impressed with the broad overall coverage of gas-turbine problems. While only three of the papers were devoted exclusively to gas turbines and installation components, many other fields of interest were touched, including operational problems, both present and future, for use of the gas turbine in commercial aircraft. The paper by George W. Brady, "Propellers for High Power and Transonic Speeds," arouses the hope that the turboprop engine will have application at much higher aircraft speeds than are at present visualized. The paper by S. J. Moyes and W. A. Pennington, "The Influence of Size on the Performance of Turbojet Engines," stimulated interesting discussion with regard to the optimum size of turbojet engines, although no predictions were ventured as to what the optimum size may be. As is so frequently the case, the formal papers and the discussions following were merely the catalytic agents for continuing discussions after the meetings, both in Brighton and during the inspection trips to the several aircraft and engine manufacturers and to Farnborough.

The static exhibitions at the S.B.A.C. show at Farnborough were extremely interesting to the American delegates. Each major engine contractor displayed cut-away models of his engine line, including engines that, in the United States, probably would not have been shown because of security restrictions. These displays included all types and sizes of engines ranging from the engines of World War II to the Napier "Nomad" and the latest gas turbines.

The "Nomad" is a compound engine combining the features of the gas-turbine and the reciprocating engine in order to achieve a specific fuel consumption of 0.36 lbs. per hp.-hr. In achieving this performance, Napier has gone to a highly sophisticated cycle and a highly complicated mechanical design that must certainly be expensive to produce. The contraprops used with this engine in the "Nomad-Lincoln" flying test bed are not mechanically connected. The forward propeller is driven by a gas turbine that in reality is an axial flow turbo supercharger. The rear half of the propeller is driven by the piston engine crankshaft that also drives a centrifugal compressor, through a gear train. The air path is through the axial compressor, the centrifugal compressor, the engine cylinders, and, thence, as exhaust gas through the turbine and a jet nozzle. The present rating is 3,000 hp., plus 320-lb. thrust sea-level static.

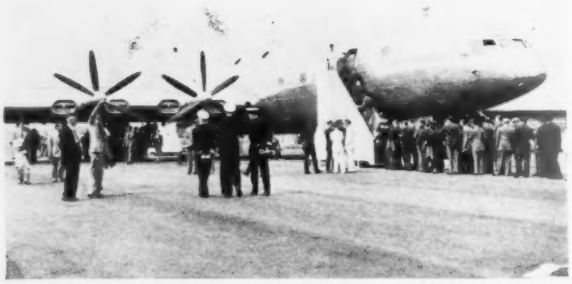
In the field of gas turbines, the displays included such engines as the Rolls-Royce "Avon" and the Armstrong Siddeley "Sapphire," together with such "old-reliables" as the Rolls-Royce "Nene" and "Derwent" and the de Havilland "Ghost" and "Goblin." Competing for attention with the engine displays were the exhibits of the many British accessory and component manufacturers.

Flying exhibitions, largely of experimental and prototype aircraft, were staged during each of the six days of the show. In spite of uncertain weather conditions, the exhibitions were well timed and most impressive to the American visitors. The wide diversity of aircraft types was most marked, ranging from flying boats and heavy freighters to medium bombers, such as the Vickers "Valiant" and delta-wing research aircraft. The Bristol "Brabazon I," powered by eight Bristol "Centaurus" reciprocating engines, was on display but was not flown.

A review of the types of gas turbines used in the various aircraft on exhibition leaves the impression that the advanced types of research aircraft use the older and, consequently, perhaps more dependable engines. For

---

* Manager, Contracts Operation.
† Manager, Research and Development Operation.



The Bristol "Brabazon I."

instance, of the five research aircraft shown, four were powered with Rolls-Royce "Nene" engines and one with the Rolls-Royce "Derwent." In the bomber class, the choice in the case of each aircraft exhibited was the new Rolls-Royce "Avon." In the fighter class, a wide range of choice was indicated, including the Rolls-Royce "Derwent," "Nene," and "Avon," and the de Havilland "Ghost." Of the two that were powered by turboprops, one used the Armstrong Siddeley "Python" and the other the Armstrong Siddeley "Double-Mamba." Of the gas-turbine-powered transports shown, three were equipped with turboprops. One used the Rolls-Royce "Dart," one the Bristol "Theseus," and one the Armstrong Siddeley "Mamba." The only turbojet transport on display, the de Havilland "Comet," was equipped with four de Havilland "Ghost" engines that are to be replaced in the production version with the Rolls-Royce "Avon."

Many trainer planes were displayed, including the de Havilland "Vampire" trainer, which was equipped with one de Havilland "Goblin" engine. Those who have followed jet aircraft progress in the past 10 years were impressed with a special version of the Gloster "Meteor," equipped with two Rolls-Royce "Avon" engines. These power plants nearly triple the power for which this aircraft was originally designed.

Visits to the various aircraft engine manufacturers indicated substantial activity in research and development, generally almost completely divorced from production activities in organization and, in some cases, geographically. Experimental shops were substantial in size and equipped to do a complete development job, generally with simple tooling and through the application of highly skilled direct labor.

The ratio of technical personnel to other personnel in development activities appeared to be approximately the same as in the United States. Engineering budgets for research and development appeared to be somewhat lower, but, because of the many variables entering into such comparisons, it would be difficult to arrive at any definite conclusions.

A major point of difference between the British and American engine manufacturers is in the methods used for development of engine components. The major engine contractors in the United States are equipped with elaborate facilities for the testing of individual engine components under conditions simulating flight operation but generally permitting more precise testing than would be possible in flight testing of a complete engine. The British, on the other hand, employ much more modest component facilities, permitting factory testing under a limited range of conditions. They then resort to flight testing in flying test beds and experimental aircraft to complete the development. There are many reasons for this difference in development philosophy; shortage of electric power for testing is one that can be mentioned here.

Production testing techniques are similar to ours, but it was of interest that at least two current production engines, the Rolls-Royce "Derwent" and the de Havilland "Goblin," now undergo a single acceptance test before shipment. On a quality-control basis, one engine in perhaps 10 or 20 undergoes a complete teardown, inspection, reassembly, and final acceptance run. This is in direct contrast to current American practice, which generally requires that each engine receive an initial run, teardown, inspection, and a final acceptance run prior to shipment. The effect of this reduced testing is to increase significantly the production capacity of a given assembly and test facility and to conserve the use of fuel. It is claimed by the British that this procedure increases average service life before first overhaul. No evidence was seen, however, that actual and allowable service life of current British turbojet engines differed significantly from current American life figures for production engines.

Manufacturing methods used in Great Britain are not dissimilar, except that a much higher ratio of highly skilled workers is required. In addition, there is much less use of single-purpose machine tools and highly advanced production methods. It is understood that production plans for the future contemplate many labor-saving methods and the use of single-purpose tools similar to those now in use in this country.

There was evidence that, in the design of their engines, the British have paid more attention to critical material limitations than has been the case in the United States. Wasteful manufacturing methods, such as machining of turbine buckets instead of forging, has tended to reduce this advantage, however.

The British aircraft engine manufacturers are making an important contribution to the development of aircraft by their interest in and, in some cases, responsibility for, the complete power-plant installation. It was reported that one British manufacturer devotes nearly as much engineering time to the development of the "other" side of the power plant as to the basic engine development itself. Inlet ducts, exhaust pipes, mounting arrangements, and, in some cases, whole nacelles or "power eggs" are designed by the engine builders. In order to achieve best aerodynamic performance consideration must be given to the effect of inlet conditions, inlet duct flow, internal engine air and gas flow, jet nozzle flow,

(*Continued on page 50*)

Hydrodynamic Notes on the Third International Aeronautical Conference

ERNEST G. STOUT*

Consolidated Vultee Aircraft Corporation

THE CASE FOR WATER-BASED AIRCRAFT had one of its most successful trials for many a year at the Third International Aeronautical Conference in Brighton, England. Before a critical jury of many of the world's most eminent aeronautical engineers, the science of seaplane hydrodynamics was received without reservation into the family of modern aeronautical sciences.

For many years, interest in efficient water-basing of aircraft has revolved around obvious facts regarding the desirability of such development with little concrete technical evidence supporting the means or configurations by which this would be accomplished satisfactorily. At the Aeronautical Conference both the rigorous research procedures and refreshingly new design configurations were presented which should lay to rest the bitter arguments and controversy that have clouded this important field of aeronautical science.

It was fitting at this meeting that a new, untried research technique, which was borrowed from the British in 1936, should be returned to England as a successful, highly developed scientific procedure capable of accurately producing radical, new water-based aircraft of supersonic performance. This research procedure, involving the testing and analysis of self-propelled dynamically similar models, was fully discussed with many examples of its unique operation and analysis. Fig. 1 shows one of the jet-propelled, radio-controlled, free-body models of a transonic water-based fighter during a take-off run.

The discussions of the new research procedures that have been developed were fully illustrated by practical applications to actual design. Fig. 2 is typical of the detail of this presentation. Judging from the prepared discussions following the paper, there was general agreement with the author's conclusions that the aeronautical sciences are now in a position to develop efficient supersonic water-based aircraft from rigous and accurate experimental data.

Coming into the water-based aircraft picture at an extremely opportune time is the well-designed, beautifully constructed Saunders-Roe "Princess" flying boat. The first of three of these aircraft is scheduled for flight within a year. They are to be operated by the R.A.F. for military transports. Fully pressurized and powered by ten turboprop engines in six nacelles, these aircraft represent the last word in efficient high-speed ocean transport. According to current plans, these huge seaplanes are to be followed at Saunders-Roe by the all jet, swept-wing seaplane known as the "Dutchess." This aircraft is characterized by its extreme clean design and high length-beam ratio hull.

Particularly encouraging is the renewed interest in high-speed water-based aircraft throughout Europe. This is particularly true in Switzerland, where the abundance of large lakes poses an interesting strategic solution to the problems of fighter strips. With the introduction of a concrete technical design approach to the water-based problem, strategists are now in a position to fully exploit the many interesting possibilities inherent in this form of high-speed aircraft which sacrifices nothing for the many added advantages.

The many excellent technical papers, discussions, conferences, and visits of the Third International Aeronautical Conference will be long remembered and dis-

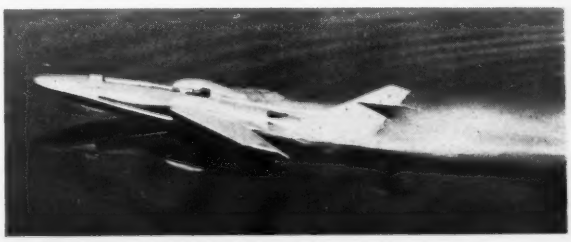


FIG. 1.

* Assistant to Chief Engineer.

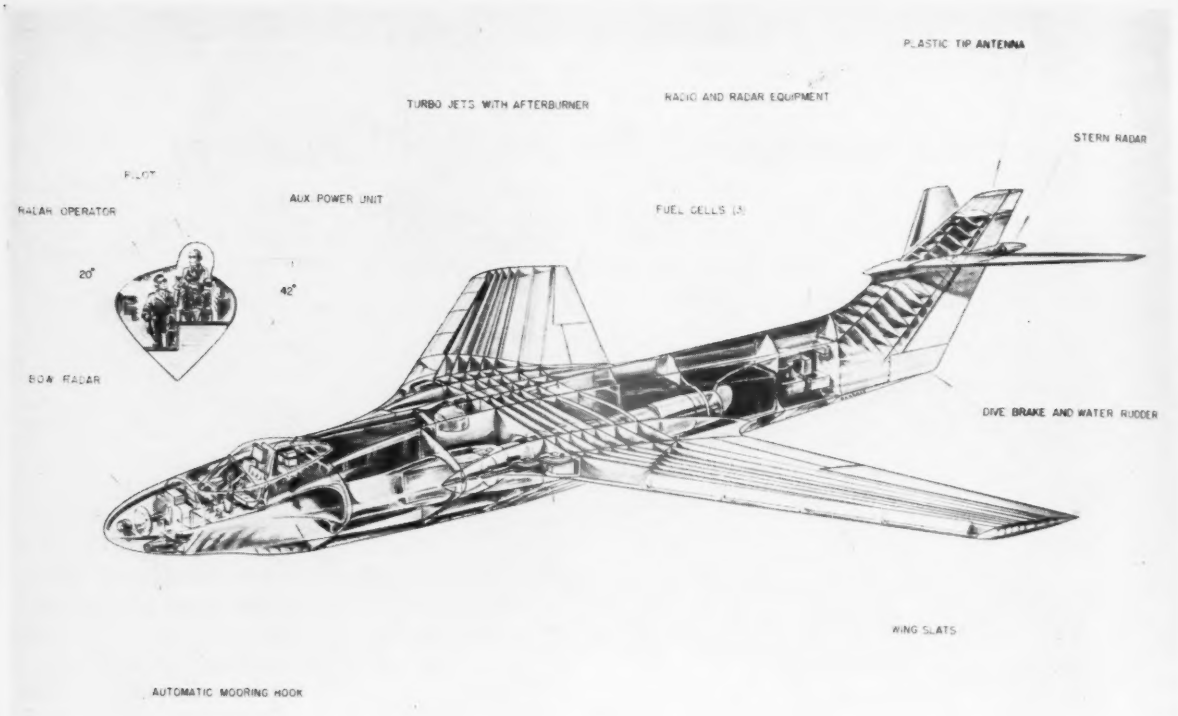


FIG. 2.

cussed by those who attended this increasingly important bi-annual international meeting. Of greater importance, however, are those new ideas and items of technical achievement which go beyond official recording in the archives and become an integral part of the daily effort of the aeronautical sciences to further extend the science of flight. In this connection, the Brighton meeting will certainly mark the turning point in the general acceptance of these hydrodynamic developments of such significant technical importance.

Comparisons of British and American Gas-Turbine Practice

(*Continued from page 48*)

and, in many cases, external nacelle air flow. These factors are all interrelated, and, since engine builders are experts in ducting, engine gas dynamics, and aerodynamics, it is felt that they are in the best position to assume the responsibility for the complete power-plant design.

Conferences such as the one in Brighton and the exchange of ideas between gas-turbine designers from both sides of the Atlantic cannot fail to impress one with the fact that the gas-turbine art has passed from the experimental to the service or operational stage. Wide differences of opinion on design philosophy are no longer apparent. There are still, and probably always will be, major variations in design details. Production techniques will always be improved as a result of the continuous exchange of ideas born of the necessity of meeting terrifically accelerated requirements. Attention must now be focused on the problems of: (1) increasing service life; (2) designing for producibility; (3) reducing of critical material content; and (4) refining of installation design for improvement in aircraft performance and, possibly, for interchangeability of different engine models. Along with all these problems that are introduced because of military requirements, it is to be hoped that some attention can be paid to the operational problems of jet- and turboprop-powered commercial transports in the United States.

Allison Turbo-Prop engines to power NEW USAF NAVIGATOR-BOMBARDIER TRAINER

Allison T38 Turbo-Prop engines will be installed in a new version of the USAF T-29 Convair Navigator-Bombardier Trainer.

With these lighter, more powerful turbine engines, the T29C will fly faster, at higher altitude and with increased range. Thus better training will be given students under conditions more closely like the operation of modern high speed bombers.

Here again the performance of Allison Turbo-Prop engines is superior to reciprocating engines.

More power — at less weight — that's why military services and aircraft manufacturers consistently are choosing Allison Turbo-Prop engines for their *better airplanes of tomorrow.*

Builders of J35 Axial, J33 Centrifugal Flow Turbo-Jet Engines T38 and T40 Turbo-Prop Engines

GM GENERAL MOTORS

Allison

DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

PROOF-TESTING ENGINES TODAY FOR THE AIRPLANES OF TOMORROW

SERVICE STATION IN THE SKY

When it comes to performing chores aboard a plane, a pneumatic system does a real "service station" job. What's more, a pneumatic system can often adjust itself to emergencies which would cause complete failure in other types of systems.

Altitude is no longer a problem. The new lightweight Kidde compressor can provide plenty of pressure at 35,000 feet and beyond. It can maintain adequate pressure even in the event of small leaks. Various other Kidde devices such as pressure switches, air fuses, check valves, relief valves work to maintain the correct pressure at all times.

Get full information about recent advances in the pneumatic field. Call or write Kidde today.

Kidde Pneumatic Aircraft Devices include:
Air Compressors, Regulators, High Pressure Containers & Valves, Selector Valves, Gun Chargers, Relief Valves, Pressure Switches, Check Valves, Moisture Separators, Pneumatic Fuses, Back-Pressure Valves.

Kidde

Walter Kidde & Company, Inc., 1211 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

I.A.S. Previews

Summaries of Current Papers Accepted for I.A.S. Publications

Please do not order Preprints of these papers at this time.

The Lift, Rolling Moment, and Pitching Moment on Wings in Nonuniform Supersonic Flow

By

Henry L. Alden and Leon H. Schindel

Massachusetts Institute of Technology

A method is developed for computing aerodynamic coefficients of wings in arbitrary nonuniform supersonic flows. It is shown that lift, pitching moments, and rolling moments can be obtained by single integrations without calculation of pressure distributions as an intermediate stage. Application of the method to wings with supersonic leading and trailing edges is formally similar to conventional strip methods but gives results that are correct within the limits of three-dimensional linearized theory.

The Interpretation of Failure Loads in the Plastic Theory of Continuous Beams and Frames

By

P. S. Symonds and B. G. Neal

Brown University and Cambridge University, Respectively

Plastic failure loads on continuous beams and rigid frames of ductile metal can be computed simply when certain assumptions concerning the moment-curvature relations are made, and it is assumed that individual loads remain in constant ratio to each other during the loading process, so that the load value is described by a single parameter. The simple theory is mainly concerned with the prediction of the maximum load a structure can carry before "plastic collapse" occurs. However, in some cases it will be desirable to estimate some of the deflections, and a case of a continuous beam is described in the paper in which the calculation of plastic failure load may be misleading unless accompanied by a deflection analysis. The deflection values that make the plastic analysis meaningful are calculated for this case by a simple approximate method that requires little additional labor after the plastic failure load has been determined, and the results are compared with test results previously published by Stüssi and Kollbrunner and by Maier-Leibnitz. The method may be used for general framed structures, and an analysis of a two-story portal frame is given as a further illustration of its use.

Experimental Investigation of Temperature Recovery and Heat Transmission on Cones and Cylindrical Bodies in Axial Flow in the N.O.L. Aeroballistics Wind Tunnel

By

G. R. Eber

U.S. Naval Ordnance Laboratory

The Naval Ordnance Laboratory research program on the investigation of aerodynamic heating effects at supersonic velocities is outlined briefly. Results of recent experimental investigations on temperature recovery and heat transmission along the surfaces of cones and cylindrical bodies in axial flow are presented. The experiments were conducted in the N.O.L. 40- × 40-cm. Aeroballistics Tunnel at Mach Numbers between 1.5 and 5.0, inclusive, and cover the regions of laminar, transition, and fully developed turbulent boundary-layer flow. The experimental results are compared with analytical solutions for temperature recovery and heat transfer with laminar and turbulent boundary layer. The qualitative effect of the direction of the heat flow and the surface temperature on the limits of the transition region is discussed in detail.

Preprint No. 335

Computation of the Laminar Boundary Layer with Suction

By

Friedrich O. Ringleb

Naval Aircraft Factory

In this paper, the incompressible laminar boundary layer is computed using, as approximate profile for the velocity u tangential to the boundary, an exponential function of a polynomial of the fourth order in y with coefficients that are functions of x. If the velocity outside the boundary layer and the suction (blowing) velocity are given functions of x, the first of those coefficients is determined by an ordinary differential equation of the first order which can be solved by numerical methods in the general case and exactly by simple analytical expressions in many special cases. The other coefficients are determined by elementary functions of the first coefficient and its first derivative. This method, which is convenient and combines high accuracy with uniformity of the procedure, is applied here to the flat plate with and without suction, the stagnation point, the asymptotic suction profile, and some other examples of interest.

Simplified Treatment of the Turbulent Boundary Layer Along a Cylinder in Compressible Flow

By

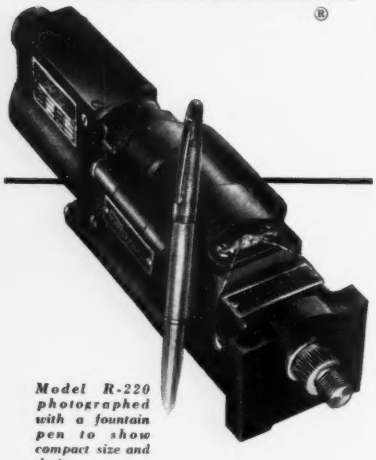
Hans U. Eckert

Wright Air Development Center

An attempt is made to determine the effect of lateral surface curvature upon the turbulent boundary layer of a circular cylinder immersed in a compressible fluid with its axis parallel to the direction of flow. The calculation is carried out by means of the momentum theorem with the assumptions that the velocity profile (1/7-power law) and an empirical relation that puts the wall shear stress inversely proportional to the fourth root of the boundary-layer thickness (Blasius law) are unaffected by the curvature. Further assumptions are constancy of static pres-

For the toughest jobs pick the huskiest

TrimTrol®



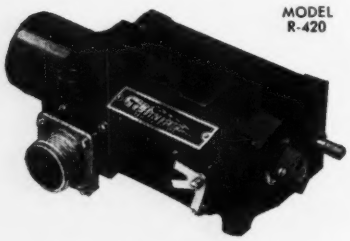
Model R-220 photographed with a fountain pen to show compact size and design.

The huskier model TrimTrols—R-220 and R-174—are being used in increasing quantities where great strength and endurance are required. Rightly so. Although these models weigh only 3½ pounds, they have an ultimate static load capacity of 2,400 pound-inches and operate loads over 300 pound-inches through 160° rotation. Zero backlash, magnetic brake, adjustable limit switches, positive overtravel stops, adjustable position-indicating potentiometer, and built-in radio noise filter are features of these TrimTrols.

Models R-220 and R-174 are identical in performance, but differ in mounting arrangements.

The newer, lighter TrimTrols—R-420 and R-422—weigh 2¼ pounds and have an ultimate capacity of 1,500 pound-inches.

MODEL R-420



AIRBORNE

ACCESSORIES CORPORATION

1414 Chestnut Avenue, Hillside 5, New Jersey
LOS ANGELES, CALIFORNIA • DALLAS, TEXAS
TORONTO, CANADA

© A.A.C.

sure and total energy. On this basis, the following results are obtained: Full thickness and displacement thickness are less than on the flat plate, while momentum thickness and local and mean friction coefficients are higher. For the displacement thickness, the deviation from the flat plate value may become appreciable if the ratio of full boundary-layer thickness to cylinder radius is less than 0.1; for the full thickness, the deviation may become appreciable if this ratio is somewhat above 0.1. The friction coefficients on the other side are rather insensitive to curvature and deviate appreciably only if the ratio becomes as large as 1. Compressibility, in general, somewhat increases the effect of curvature except for the displacement thickness, where a slight decrease is found. The reliability of the basic assumptions and effects of their variation are discussed.

Column Behavior Under Conditions of Impact

By

George Gerard and Herbert Becker

New York University and Combustion Engineering-Superheater, Inc., Respectively

The magnitude of the stress introduced into a long slender bar by velocity impact depends only upon the conditions of impact. Thus, buckling of this bar under impact loading can only take place after the compressive stress wave has propagated over a "critical" length of the bar. Column behavior under impact is studied theoretically and by a novel experimental technique, and it is concluded that a column can momentarily support a dynamic compressive stress of any magnitude which may be introduced by impact.

Supersonic Flow Around Cones at Large Yaw

By

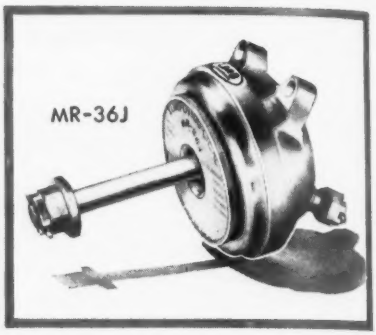
G. B. W. Young and C. P. Siska

The RAND Corporation

Equations have been developed for the flow properties in the region bounded by a supersonic cone body at large angle of attack and its attached shock wave, for use with the tabulations of Kopal. A comparison of the theoretical results is made with the experimental data of Cronvich. A slight discrepancy, which increases with increasing Mach Number, has been found in the value of K_{DYH}, the yawing head drag as tabulated by Kopal.

Increase Payload

20 lbs. for Convair 240
40 lbs. for Douglas DC-6



LORD DYNAFOCAL REWORK PLAN

Here is an opportunity for operators of 240's and DC-6's to add extra payload capacity by reducing gross weight.

Many of these airplanes were built before LORD developed the lightweight MR-36J Dynafocal which saves ten pounds of weight per engine mounting assembly. The LORD rework plan enables operators to return genuine LORD MR-36F Dynafocals to the factory for rework into the lighter MR-36J design. All parts receive 100% inspection . . . new rubber is bonded into cores . . . various metal parts are machined to new contours . . . and components showing undue wear are replaced with new ones.

Thus—at a fraction of the cost of new mountings—you receive factory rebuilt Dynafocals which incorporate the latest LORD design features. The weight is reduced to 30.5 pounds per assembly without sacrifice of strength or performance. Write to the attention of Product and Sales Engineering Department for specific information.

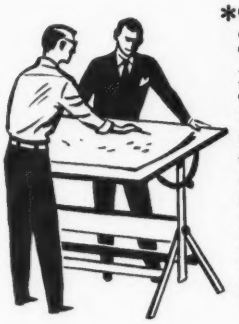
LORD MANUFACTURING COMPANY
ERIE, PENNSYLVANIA

LORD
BONDED RUBBER

Vibration-Control Mountings . . . Bonded-Rubber Parts

GUIDANCE & CONTROL SYSTEM UNITS

...complex design, development and production is simplified by the PACIFIC SCIENTIFIC METHOD*



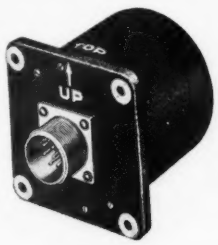
*Qualified Pacific Scientific Co. engineers are available to you. Their knowledge, gained thru years of experience in radar, electronics and other guidance methods is combined with the skill of men who know how to develop and produce . . . *on time!* If you have a problem of guidance or control in aeronautics, *we can simplify your problem.* Just phone or wire our nearest office and a qualified Pacific Scientific Co. engineer will be at your service.

HUMPHREY LINEAR POTENTIOMETER

For absolute linear signal accuracy this light weight yet rugged device is unsurpassed. Push-pull brush travel can be varied to suit specifications. Standard Unit has 2 resistance elements for 10,000 ohm resistance. Unit can be furnished with standard Winchester plug or plain pigtail lead-ins. Sealed construction keeps out dirt and oil which might interrupt efficient operation.

HUMPHREY ACCELEROMETER

This small, sturdy unit has high natural frequency, 20 cps. to 50 cps., in ranges from a max. of 4G to 50G. It has two 20,000 ohm potentiometer take-offs with high sensitivity and accuracy. Unit is viscous damped and unaffected by acceleration in other planes or by rotary accelerations.



HUMPHREY TIMER

This type instrument built only to specifications

The special unit shown is extremely accurate and thoroughly dependable due to its sturdy construction. Making and breaking multiple contacts in specified time sequence it may be used in flight control systems or test equipment. Included in the unit is a very accurate automatic re-zeroing mechanism.

HUMPHREY GYROSCOPES

RATE GYROS of this type provide control or telemetering intelligence for missile or aircraft systems. This model has two potentiometer take-offs, is viscous damped. Light in weight yet rugged, this instrument can be built to cover a wide range of sensitivity requirements.

RATE SWITCHES to control vertical gyro operation during plane maneuvers are available to specification.

FREE GYROSCOPES. This model has full 360° freedom in the roll axis and plus and minus 80 degrees in the pitch axis. Unit has 3 phase 400 cycle, 115 volt motor operating at 23,000 rpm. Sealed in an aluminum case with "O" ring seal, signals are brought out on an AN connector. Instant uncaging and caging is obtained thru solenoid operated cams.

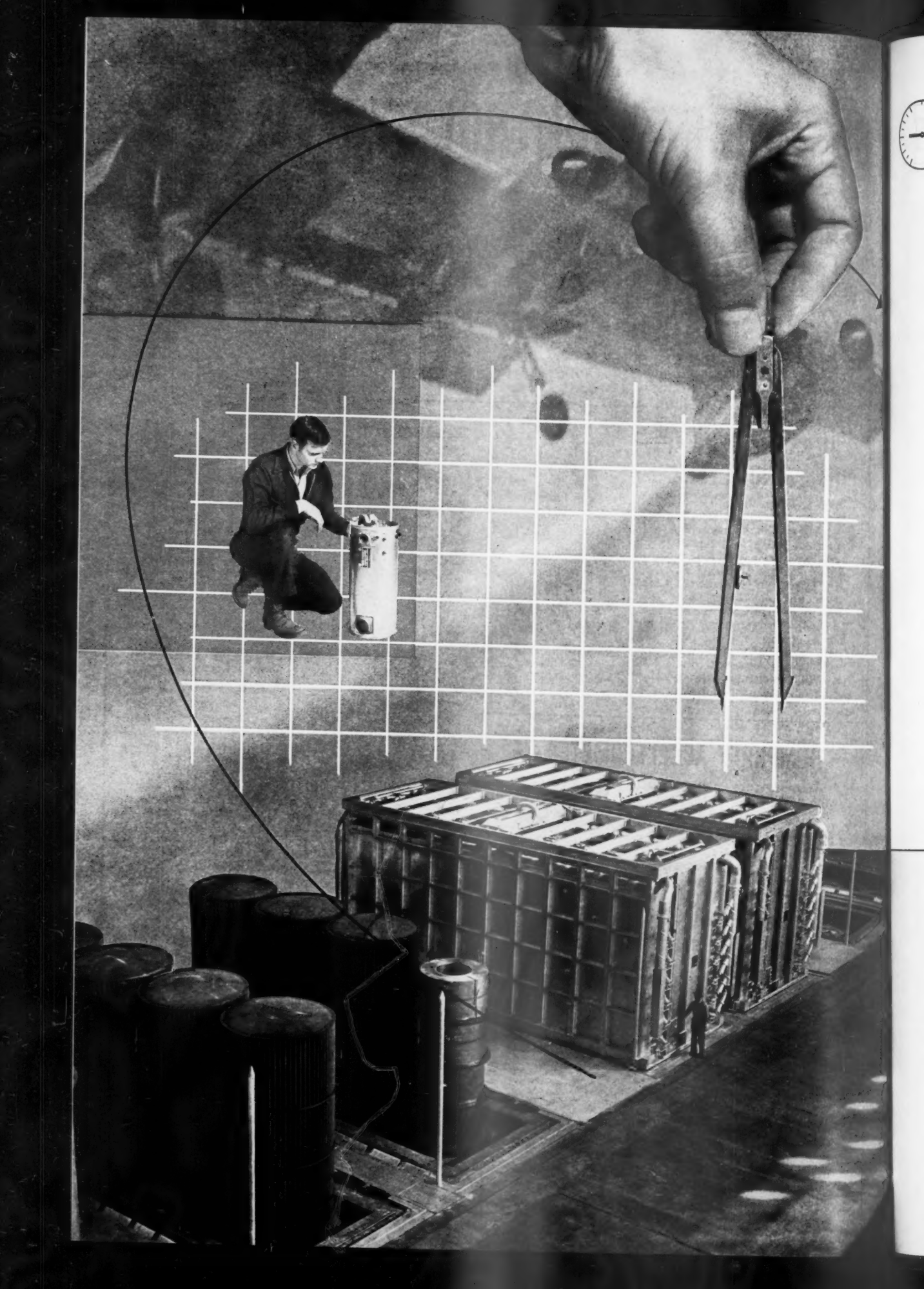
Write or wire our nearest office

Pacific SCIENTIFIC CO.

1430 Grande Vista Ave., Los Angeles 23, Calif.
25 Stillman St., San Francisco 7, Calif.
1915 1st Ave. South, Seattle 4, Washington

EASTERN REPRESENTATIVE

Aero Engineering, Inc., 288 Old Country Road, Mineola L.I., New York
54 Monument Circle, No. 310, Indianapolis 4, Ind.
8-10 South St., No. 30 Baltimore, Maryland
No. 217 Transatlantic Administration Bldg.
Montreal Airport, Montreal Quebec Canada



METALLURGY: MILES LONG—SKY HIGH

Airplane parts, whether ferrous or non-ferrous—sheet, rod, wire, or shapes—forgings, castings, or assemblies—generally require heat treatment to bring their physical characteristics up to maximum values . . . to achieve optimum strength-weight ratios, durability, and dependability. In a large number of cases such parts get their wings, so to speak, in furnaces designed and built by Surface Combustion engineers.

For example, one 'Surface' installation can process 36,000 pounds of aluminum forgings in six pit-type radiant tube furnaces. Each furnace is five feet in diameter and more than twelve feet deep. This is not a small installation, yet it is dwarfed by comparison with many 'Surface' furnaces made for the steel industry.

The largest and most recently activated coil annealing furnace installation, shown at left, accommodates 450 tons of steel in each of 60 units, permitting a total of 27,000 tons of steel to be in process at one time . . . a tonnage equivalent to that of a medium-sized aircraft carrier.

"Sky-high" physical properties and mile-long furnace installations are just two dimensions of Surface Combustion's long experience in metallurgy. Such experience has helped make the tradename "Janitrol" a sign of continuing and dependable service throughout the industry wherever aircraft heating and combustion equipment is required. Many airframe companies make it a practice to call the nearest Janitrol representative early in the preliminary design stage.

35 years' experience in Combustion Engineering.

New York, N. Y.: F. H. Scott, 225 Broadway
Kansas City, Mo.: C. B. Anderson, 2201 Grand Ave.
Hollywood, Calif.: L. A. Curtin, 7046 Hollywood Blvd.
Washington, D. C.: F. H. Scott, 4650 East-West Highway
Columbus, Ohio: Phil A. Miller; Frank Deak, USAF Coordinator
Columbus, Ohio: Engineering, Production, and Sales, 400 Dublin Ave.
Toledo, Ohio: Headquarters

AIRCRAFT-AUTOMOTIVE DIVISION, SURFACE COMBUSTION CORPORATION, TOLEDO 1, OHIO

HEATERS WITH THE WHIRLING FLAME

Janitrol®

I.A.S. News (Continued from page 21)

piro is also a member of Aircraft Industries' Alternate Steels Panel.

▶ **Luther P. Spalding** (M.), Chief Research Engineer, North American Aviation, Inc., is directing the work of a subcommittee of the Aircraft Research and Testing Committee, Aircraft Industries Association of America, Inc. The objective of this subcommittee is to permit the rapid evaluation of boron steels as they are introduced into the aircraft industry.

▶ **Juan T. Trippe** (A.M.), President, Pan American World Airways, Inc., was presented with the Foreign Traders Association award for his "distinguished contribution to American commerce and world trade through air transportation." The presentation took place at the association's annual meeting on September 25; Mr. Trippe is the eighth recipient.

▶ **Franki Lou van der Wal** (T.M.) is a predoctoral fellow in aeronautics at the Royal Institute of Technology, Sweden, during the 1951–1952 academic year. Mr. van der Wal was associated with Douglas Aircraft Company, Inc., as a Servomechanisms Engineer.

▶ **Dr. Theodore von Kármán** (H.F.), Chairman, Scientific Advisory Board, Department of the Air Force, U.S.A.F., received one of the Fulbright awards for lecturers and research scholars.

NEW APPOINTMENT

A. R. Weckel (M.) was named General Sales Manager of Sperry Gyroscope Company, Division of The Sperry Corporation. For the present, he will also continue in his former capacity as Director of Commercial Sales. Mr. Weckel, a 1929 graduate in electrical engineering of Kansas State College, has been with Sperry Gyroscope for the past 17 years.

▶ **J. Carlton Ward, Jr.** (M.), Chairman of the Board, Thompson Industries, Inc., is assisting the U.S. Air Force in directing and coordinating the many phases of the $210,000,000 program for construction and erection of the heavy forging and extrusion presses.

Members on the Move

The purpose of this section is to provide information concerning the latest affiliations of I.A.S. members. All members are, therefore, urged to notify the News Editor of changes as soon as they occur.

Frank Henry Abar, Jr. (T.M.), now Road Test Engineer, Chrysler Corporation.

Kenneth R. Alter (T.M.), Design Engineer, Peters-Dalton, Inc. Formerly, Student, University of Detroit.

Robert E. Arndt (T.M.), Works Manager, Valve Products, Inc. Formerly, Associate Engineer, Armour Research Foundation.

Guy E. Beardsley, Jr. (A.F.), now Development Engineer in Charge of Functions of Auxiliary Development, Instrumentation, and Research, Pratt & Whitney Aircraft Division, United Aircraft Corporation.

Dr. Robert H. Boden (T.M.), Consulting Engineer (Research Specialist), Aerophysics Laboratory, North American Aviation, Inc. Formerly, Supervisor of Combustion and Propulsion Activities, Aeronautical Research Center, University of Michigan.

Edmund D. Brown (T.M.), now Project Engineer on Burners, Pratt & Whitney Aircraft Division, United Aircraft Corporation.

E. R. Childs (A.F.), Head of Analysis Section, Electronics Division, Willys-Overland Motors, Inc. Formerly, Head, Aerophysics Department, Frederic Flader, Inc.

Homer V. Cooper, Jr. (M.), Supervisor, Flight Test, Aerophysics Laboratory, North American Aviation, Inc. Formerly, Flight Test Project Engineer, Northrop Aircraft, Inc.

Albert H. Demchak (T.M.), now Engineer in Training, Worthington Pump and Machinery Corporation.

Edward A. Drury (T.M.), Analytical Engineer, Power Generators, Ltd. Formerly, Junior Engineer, Boeing Airplane Company.

Monroe P. Epstein (T.M.), now Engineering Draftsman "B," Engineering Department, Lockheed Aircraft Corporation.

David N. Foner (T.M.), Senior Analytical Engineer, Mechanical Metallurgy Department, Hamilton Standard Division, United Aircraft Corporation. Formerly, Analytical Engineer, Hamilton Standard.

David A. Francis (M.), now Vice-President, Micro Balancing, Inc.

Robert E. Gorton (M.), now Instrumentation Development Engineer, Pratt & Whitney Aircraft Division, United Aircraft Corporation.

Boone T. Guyton (M.), Director, Contract Liaison, Norden Instruments, Inc. Formerly, Chief Pilot, Military Liaison, Chance Vought Aircraft Division, United Aircraft Corporation.

Captain George P. Haviland, U.S.A.F. (T.M.), Wright Air Development Command, Wright-Patterson Air Force Base, Ohio. Formerly, Research Assistant, Massachusetts Institute of Technology.

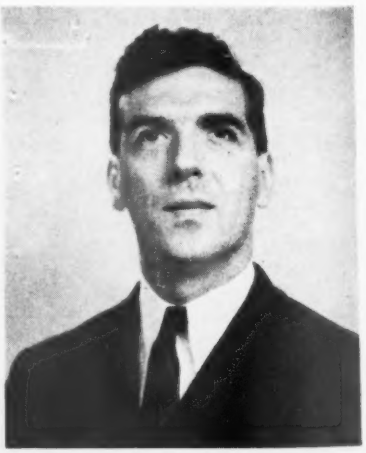
Herbert Gerald Herrington, Jr. (T.M.), now Junior Engineer "B," Boeing Airplane Company.

Dr. Sighard F. Hoerner, Ing. (M.), Gibbs and Cox, Inc. Formerly, Air Materiel Command, Wright-Patterson Air Force Base, Ohio.

Paul E. Hovgard (F.), Management Engineer, Griffenhagen and Associates, Chicago. Formerly, Assistant Manager, Engineering Department, Fairchild Aircraft Division, Fairchild Engine and Airplane Corporation.

Claude R. Howard (T.M.), Aerophysics Engineer, Fort Worth Division, Consolidated Vultee Aircraft Corporation. Formerly, Graduate Student, University of Oklahoma.

George R. Huisman (T.M.), now Vice-President and Chief Engineer, Plexolite Corporation, Los Angeles.



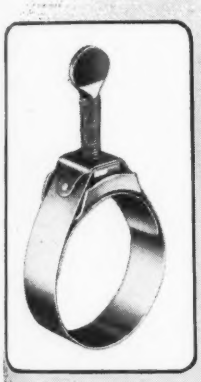
NEW POSITION

Maurice H. Smith (T.M.) has become Research Associate in Charge of Technical Libraries, James Forrestal Research Center, Princeton University. In this capacity, he works in close cooperation with the Director of the Center, Professor Daniel C. Sayre (A.F.). Prior to accepting this position, Mr. Smith had been with the Institute of the Aeronautical Sciences for almost 10 years as Librarian. He also served as Book Reviews Editor for the AERONAUTICAL ENGINEERING REVIEW *and assisted in the compilation of the* AERONAUTICAL ENGINEERING INDEX *for the years 1947–1950. Mr. Smith's former duties at the Institute have been assumed by John J. Glennon (A.M.), now Acting Librarian.*

For Dependable Hose Connections

WITTEK
STAINLESS STEEL
Aviation
HOSE CLAMPS

For over a quarter century, Wittek has specialized in hose clamps, devoting craftsmen's skills to producing hose clamps of uniform accuracy in clamping action combined with superior physical strength, for dependable leakproof hose connections. This experience is yours when you place your aircraft hose clamp requirements with us.



WITTEK FBSS
(Radial Type)

Made of stainless steel and utilizing the Wittek Floating Bridge. Tested and proved for dependable service on all types of aircraft applications. Long accepted as the standard of the industry.

WITTEK WWD
(Tangential Type)

Made of stainless steel and available in all standard aircraft sizes. Also furnished in diameters up to 12" for duct and other special applications. Permits easy installation when hose is in place.

Meet current AN specifications and have C.A.A. approval.

Write for Details

WITTEK *Aviation* HOSE CLAMPS

MANUFACTURING CO.
4332 West 24th Place, Chicago 23, Illinois

Corporal Orlin M. Jacobson (T.M.), 9393 T.S.U., W.S.P.G., Las Cruces, N.M. Formerly, Mathematician "A," North American Aviation, Inc.

Orin Johnston (M.), now Assistant to Manager of Aero Operations in Charge of Engineering and Manufacturing, Aeronautical Division, Minneapolis-Honeywell Regulator Company.

Marvin J. Kahn (M.), Chief, Structures and Aerodynamics Department, Aircraft Armaments, Inc. Formerly, Structures Engineer, Republic Aviation Corporation.

Major William H. Kuhlman, Jr. (M.), Project Officer in Design Aerodynamics, Wright-Patterson Air Force Base, Ohio. Formerly, Aerodynamicist, Douglas Aircraft Company, Inc.

John J. Mance (T.M.), now Tool Designer, Frank Mayer Engineering Company.

Gene May (M), Chief of Flight Operations, Tulsa plant, Douglas Aircraft Company, Inc. Formerly, Chief Research and Test Pilot, Douglas.

Dale W. McKee (M.), now Chief Engineer, Lull Manufacturing Company.

Lieutenant George S. Metteer, U.S.A.F. (T.M.), now 3401st Stu. Sq. (O), Keesler Air Force Base, Miss.

Dr. Felix E. Nagel (A.F.), Design Engineer, Advanced Design Section, Aircraft Gas Turbine Divisions, General Electric Company. Formerly Design Engineer, Thermal Power System Division, G-E.

Thomas E. Neal (T.M.), Staff Assistant, Aircraft Division, Kaiser-Frazer Corporation. Formerly, Engineer, Continental Aviation and Engineering Corporation.

Gaylord W. Newton (M.), Chief, Engine Test Facility, Arnold Engineering Development Center, ARO, Inc., Tullahoma, Tenn. Formerly, Chief, Power Plant Unit, Boeing Airplane Company.

George A. Page, Jr. (F.), Director of Research and Engineering, Aeronca Manufacturing Corporation. Formerly, Administrative Engineer, Airplane Division, Curtiss-Wright Corporation.

I. F. Richardson (M.), Manager of Aircraft Products Sales, Aircraft Section, Bendix Products Division, Bendix Aviation Corporation. Formerly, Assistant General Sales Manager, Aircraft Equipment, Bendix Products.

Captain Franklin J. Ross, U.S.A.F. (M.), now Radar Electronics Officer, 790th AC/W Sqdn., Kirksville, Mo.

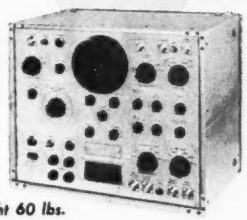
Rear Admiral A. B. Scoles, U.S.N. (Ret.) (A.F.), Resident Administrator, Guided Missile Division, Consolidated Vultee Aircraft Corporation. Formerly, Special Technical Assistant, Aerojet Engineering Corporation.

Robert K. Souter (M.), Intelligence Specialist (Meteorology and Navigation), Operations Analysis Section, Headquarters, Tactical Air Command, Langley Air Force Base, Va. Formerly, Head, Flight Meteorology, N.A.C.A., Langley Air Force Base, Va.

W. Z. Stepniewski (A.F.), Chief Aeronautical Research Engineer, Piasecki Helicopter Corporation. Formerly, Chief of Aerodynamics, Piasecki.

THE LAB PULSESCOPE®
BY WATERMAN

MODEL S-5-A



Weight 60 lbs.
13" x 16" x 14"

Another Waterman first, a compact, portable wide band pass laboratory oscilloscope with markers that are triggered in synchronism with the incoming signal. Ideal for pulse measurements, such as shape, amplitude, duration and time displacement. S-5-A LAB PULSESCOPE is adaptable to all kinds of electronic work where knowledge of circuit performance is essential. Built in Video delay permits observation of leading edge of triggering pulse. Precision means of amplitude calibration are provided. Sweep can be either repetitive or trigger with 10 to 1 expansion when desired. Internally generated markers, together with Video calibration, provide quantitative data of amplitude, shape, duration and time displacement of pulses. The oscilloscope thus is truly a PULSESCOPE, another Waterman first.

Video amplifier up to 11 mc... Video Delay 0.55 μs... Pulse rise and fall time better than 0.10 μs... Video sensitivity 0.1v p to p/in... Sweep 1.2 μs to 120,000 μs with 10 to 1 sweep expansion... Sweep triggered or repetitive ... Internal markers synchronized with sweep from 0.2 μs to 500 μs... Trigger generator with output available externally... Built in precision amplitude calibrator... Combination case ... Operates on 50 to 1000 cycles at 115V AC.

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

WATERMAN PRODUCTS INCLUDE:

S-4-A SAR	PULSESCOPE
S-10-B GENERAL	POCKETSCOPE
S-11-A INDUSTRIAL	POCKETSCOPE
S-14-A HIGH GAIN	POCKETSCOPE
S-14-B WIDE BAND	POCKETSCOPE
S-15-A TWIN TUBE	POCKETSCOPE

Also RAKSCOPES, RAYONIC Cathode Ray Tubes and other equipment

WATERMAN PRODUCTS

Colonel George F. Taylor, U.S.A.F. (A.F.), Staff Weather Officer, Air Research and Development Command, U.S.A.F., Baltimore, Md. Formerly, Staff Weather Officer, Joint Task Force 3 (Operations Greenhouse).

Lieutenant John H. Watson, U.S.A.F. (T.M.), Student Officer in Electronics, 3401st Student Squadron (O), Keesler Air Force Base, Miss. Formerly, Aeronautical Engineer, Preliminary Design, Aircraft Laboratory, Air Materiel Command, Wright-Patterson Air Force Base, Ohio.

Lieutenant Ernest A. Weil, U.S.A.F. (T.M.), Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. Formerly, Design Engineer, Teleflex, Inc.

Harry E. Wiener (T.M.), Time Study, AC Spark Plug Division, General Motors Corporation. Formerly, Cargo Sales Representative, Northwest Airlines, Inc.

Dr. Chung Hua Wu (M.), Professor, Mechanical Engineering, Polytechnic Institute of Brooklyn. Formerly, Aeronautical Research Scientist, Lewis Flight Propulsion Laboratory, N.A.C.A.

Private Ronald N. Yee (T.M.), Co. C, 502nd Abn. Inf. Regt., 101st Abn. Division, Camp Breckinridge, Ky. Formerly, Junior Engineer, Chance Vought Aircraft Division, United Aircraft Corporation.

Rudolph J. Zoudlik (T.M.), Layout Draftsman, The Glenn L. Martin Company. Formerly, Engineer, Piasecki Helicopter Corporation.

Proved RELIABILITY

Lamb Electric

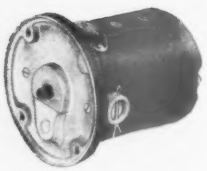
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

Over the years, reports from many users of products and devices powered with Lamb Electric Motors have emphasized the trouble-free operation of the motor.

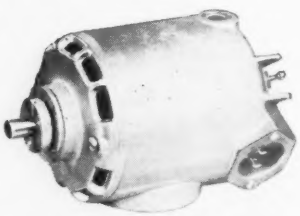
Reliability, a prime requisite for successful product operation, is assured in Lamb Electric Motors because (1) the motor is designed for the specific application, (2) it is built of quality materials to the highest manufacturing standards, (3) it embodies 36 years' experience in the small motor field.

Thorough dependability is one of the reasons why Lamb Electric Motors are used by leading manufacturers. *The Lamb Electric Company • Kent, Ohio.*

THEY'RE POWERING AMERICA'S *Finest* PRODUCTS



Series motor suitable for many intermittent duty applications where space and weight are important considerations.



Having inbuilt control switch and receptacle, this motor is readily adaptable to portable tools and equipment.

Lamb Electric

SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

Necrology

Joseph G. Derwingson

Joseph George Derwingson, A.M.I.A.S., died on June 28 as the result of a coronary heart attack. He was 38 years old.

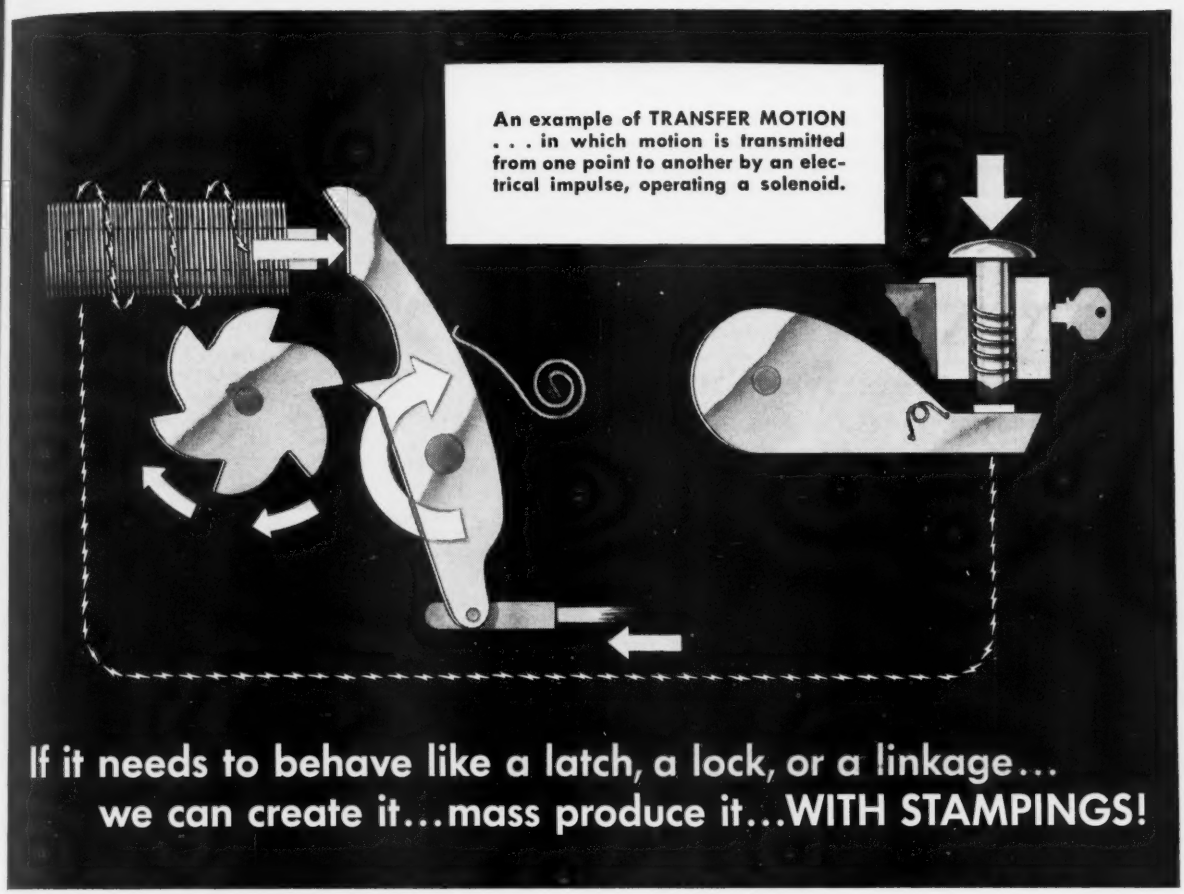
Mr. Derwingson, a native of Baltimore, held C.A.A. licenses as a designated aircraft inspector, an A. & E. mechanic, and a commercial pilot. His first employment in the aircraft industry was as a Mechanic in China for United Aircraft Export Corporation. Remaining with this company for about 7 years, he became a Service Representative before leaving there in 1935. With the exception of about 6 months with Pratt & Whitney Aircraft Division of United Aircraft Corporation, he was associated with Consolidated Vultee Aircraft Corporation for approximately 8 years. During that period, he was promoted from Assemblyman 2nd class through various positions to that of Service Engineer–Staff Assistant. Leaving Convair, he went as Manufacturing Engineer with Avion, Inc., and, several years later, joined the staff of North American Aviation, Inc. While with North American, he was sent to England as Field Service Representative. He was with W. H. Coffin Air Service for a while and, at the time of his death, was employed by the Aviation Gas Turbine Division, Westinghouse Electric Corporation, in the capacity of Field Service Engineer at the Naval Air Station, Moffett Field, Calif.

Mr. Derwingson is survived by his wife and their two children.

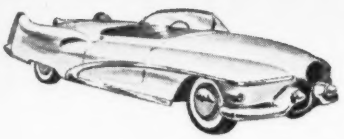
Col. A. D. Tuttle

Colonel Arnold Dwight Tuttle, U.S.A. (Ret.), M.D., M.I.A.S., died on October 6 from a heart ailment. His age was 71.

A native of Sturgis, N.D., Colonel Tuttle was graduated with an M.D. degree from the University of Maryland in 1906. Three years later, he was an honor graduate of the Army Medical School and was appointed a First Lieutenant in the U.S. Army Medical Corps. During World War I, he served as a member of the Medical Corps of General Pershing's staff. In 1933, after attending the Graduate School of Aviation Medicine, Colonel Tuttle was appointed Commandant of the School of Aviation Medicine, Randolph Field, Tex. After 4 years in this capacity, he retired from the Army to accept the position of Medical Director with United Air Lines, Inc. He resigned from this position


An example of TRANSFER MOTION
. . . in which motion is transmitted from one point to another by an electrical impulse, operating a solenoid.

If it needs to behave like a latch, a lock, or a linkage...
we can create it...mass produce it...WITH STAMPINGS!

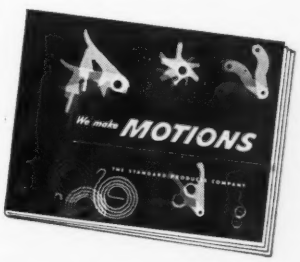


You may want a motion device that can be operated electrically—or manually. We design and produce both.

The "motion" illustrated above is one in which our research and engineering ingenuity have been applied in the development of a mechanism designed for electrical operation of an automobile door—for General Motors' experimental Le Sabre car. Just as Le Sabre represents forward-looking automotive design, so does Standard Products engineering "look ahead" in the design of special types of motion-mechanisms. We can design similar mechanisms to operate either electrically *or* manually—*or both*.

Furthermore, by employing modern mass-production and machine assembly techniques, we can make such motion devices with *stampings* . . . to keep the cost unusually low.

For further information about our facilities, write for a copy of our booklet, "We Make Motions".



THE MARK OF A SUPERIOR PRODUCT

The Standard Products Co.

DEPT. F, GENERAL OFFICES: 2130 WEST 110 STREET • CLEVELAND 2, OHIO
DETROIT SALES OFFICE: 316 FISHER BUILDING, DETROIT 2, MICHIGAN

WE MAKE MOTIONS

last June 1; however, he remained associated with the company in the capacity of consultant.

Colonel Tuttle was awarded The John Jeffries Award for 1949 "for outstanding contributions to the advancement of aeronautics through medical research." This presentation was made by the Institute of the Aeronautical Sciences at the Honors Night Dinner on January 23, 1950.

In addition to his Institute membership, Colonel Tuttle belonged to the American Medical Association, Association of Military Surgeons of the United States, Aero Medical Association, American College of Surgeons, and National Aeronautic Association.

Colonel Tuttle is survived by his widow, Mrs. Adrianne Tuttle; his mother, Mrs. Ann S. Tuttle, of Baltimore; and three sisters.

Corporate Member News

• **Al-Fin Division, Fairchild Engine and Airplane Corporation** . . . The Al-Fin process—that of molecularly bonding aluminum and steel—has been utilized to connect hydraulic servomechanisms with their actuating controls for a missile application. A simple, compact, and lightweight housing is produced which contains the connecting lines and the actuating pistons so that the hydraulic cylinders become integral parts of the unit. Passageways through the housing are thin-walled steel tubes preformed to follow their required paths. . .A license for the manufacture of molecular bonded bimetallic pistons has been granted to Zollner Machine Works. Under the terms of the license agreement, the Aluminum Company of America and Bohn Aluminum and Brass Corporation will use the patented Al-Fin process in bonding and casting operations in production of piston castings for Zollner, said to be the largest U.S. supplier of pistons for heavy-duty engines.

• **Allis-Chalmers Manufacturing Company** . . . The Electrical and Mechanical Power departments have been combined to form the Power Department. In another organizational change, the Centrifugal Pump Department becomes a section of the Power Department . . . The funds created by a recent $40,000,000 bank credit agreement are being used to finance Allis-Chalmers' increased defense production contracts. The notes on the bank loan are guaranteed to the extent of 70 per cent by the Federal Reserve Bank of Chicago as agent for the Department of the Army . . . A new small synchronous motor that operates on the reluctance principle and has no brushes, slip rings, rotating coils, or permanent magnet has been announced. The motor, measuring approximately 4 in. in diameter and $2^3/_8$ in. in length, can be built to operate continuously at any voltage below 250 volts, either single phase or polyphase. The motor is able to start without starting equipment and pull into any step at any frequency from 10 to 400 cycles. It was developed primarily for military or special industrial equipment.

• **Aluminum Company of America** . . . Construction work on a new aluminum smelting plant at Rockdale, Tex., was scheduled to have been started in October. This facility at Rockland is expected to be in partial operation late in 1952. When full operation is reached in 1953, the aluminum producing capacity of the plant will be in the neighborhood of 170,000,000 lbs. annually.

• **American Airlines System** . . . Twenty-four DC-6B passenger planes and six DC-6A cargo planes have been ordered from Douglas Aircraft Company with delivery for 1953. These 30 planes are in addition to the 17 DC-6B's which are being delivered this year to American. When both orders of DC-6B's and DC-6A's are delivered, American will have increased its present number of seats available by 37 per cent and will have doubled its cargo capacity.

• **Beech Aircraft Corporation** . . . A major portion of the remaining facilities at the old Liberal Field, Kan., has been taken over by Beech for military aircraft production activities. Liberal was an Air Force facility during World War II.

• **Bell Aircraft Corporation** . . .The 1951 National American Legion Award "for having the most outstanding record for employment of physically-handicapped veterans" of any employer in New York State was presented to Bell at formal ceremonies shortly after the Legion's national convention in Miami, Fla., on October 15. Of the 10,500 workers employed, 9,123 are men. A total of 4,113, or 46 per cent of the men workers, are veterans. Of this amount 943, or 23 per cent, are disabled.

• **Bendix Products Division, Bendix Aviation Corporation** . . . The automotive and aircraft sections were recently separated and placed under different managers.

• **Boeing Airplane Company** . . . A new aircraft spark plug has been designed and built by Boeing. Tagged the "anti-fouling spark plug," it features electrodes that are ostensibly not subject to heat, impact, or erosion. The new plug is undergoing extensive testing to determine its performance data.

• **Canadair, Ltd., and Lockheed Aircraft Corporation** . . . An agreement has been entered into between the Canadian government and Lockheed whereby Canadair is to produce the Lockheed T-33 jet trainer, a development of the F-80 Shooting Star, in quantity for the Royal Canadian Air Force. Canadair is also building the North American F-86 Sabre and the Beech T-36A trainer.

• **Cessna Aircraft Company** . . . The Army's L-19 observation and liaison plane, manufactured by Cessna, has been named the "Birddog." This name was one of those suggested for this ship in a Cessna employee contest.

• **The Cleveland Pneumatic Tool Company** . . . The Clayborne engine stand equipment line has been purchased from

THE MARTIN MATADOR

Designated by the U.S. Air Force as the B-61, a radar-guided Matador pilotless bomber is shown being launched on a rocket-assisted take-off. After speed is reached, the rocket bottle on the underside of the tail structure drops off and a turbojet engine then takes over. A radio aerial permits the B-61 Matador to receive command signals that direct its flight; the pilotless bomber is tracked by radar stations down range, telemetering information back to the base. The Matador, which is reportedly a refinement of the German V-1 and might be described as a smaller version of the Martin B-51 medium bomber, is approximately 30 ft. long and has clipped wings that are swept back to about a 30° angle. The B-61 is to be the initial equipment of the 1st Pilotless Bomber Squadron (Light), which was established this fall at the U.S.A.F. Missile Test Center, Cocoa, Fla. The preliminary training of this squadron in the tactical use of the guided missile, or pilotless bomber, is to be carried on by the 6555th Guided Missile Wing, a part of the Air Research and Development Command. Later, the unit will be prepared for combat by extensive training under the supervision of the Tactical Air Command.

for Versatility in force measurement

HAGAN THRUSTORQ

HAGAN HALL BUROMIN CALGON

Whenever you have a force measuring problem—consider Hagan THRUSTORQ. This partial list of applications now being handled successfully by this simple and accurate device will give you some idea of its possibilities.

- cradle dynamometer measurement of airplane and automobile engines
- single cylinder engine test stands
- evaluating turbine blade shapes
- measuring torque of helicopter engines
- automatic batch weighing
- measuring thrust of jet engines and rockets
- testing piston rings
- chassis dynamometers
- axle testing machines

If you think Hagan THRUSTORQ may be the answer to some of your problems, write us about it. Our engineers are at your service.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA

HAGAN THRUSTORQ
measuring thrust and torque *with air!*

Tech-Forge *flexible* Couplings

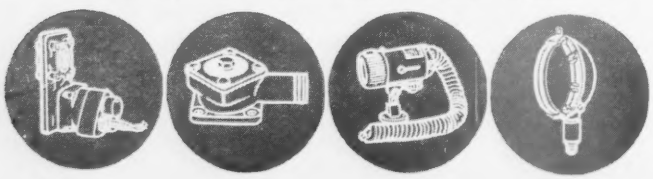
for extra strength and resilience—plus lighter weight

Standard-Thomson Tech-Forge bellows make the ideal flexible coupling for practically every aircraft use—exhaust, cabin heating, de-icing systems, etc. Forged and fabricated by an exclusive process, stainless steel Tech-Forge bellows can be furnished in sizes from ¾" to 36" I.D. In any size, the Tech-Forge process assures minimum thinning of the fabricated metal, so that comparatively light-gage metals can be used to advantage, without loss of strength. For full engineering details, or recommended specifications, write:

STANDARD-THOMSON CORPORATION • DAYTON 2, OHIO

Standard-Thomson

Makers of USAF-approved bellows • valves • lights



Shut-off Valves | Barometric Pressure Valves | Cockpit Lamp Assembly | Vaporproof Cabin Lamp

Clayborne Manufacturing Company with the intention of strengthening Cleveland Pneumatic's position as a supplier to the nation's automotive and aircraft industries. Included in the transaction are complete patent and manufacturing rights, machinery, tools, and the entire inventory of finished products and materials in process for Clayborne engine assembly and overhaul stands, dollies, racks, brackets, and adapter frames. The Clayborne name will be continued with the addition of Cleveland Pneumatic's Aerol brand name. Sales of this new Clayborne line are being handled by the Automotive Division of Cleveland Pneumatic . . . Major General Frederick M. Hopkins, Jr., U.S.A.F. (Ret.), has joined the firm as Vice-President and Assistant to the President.

• **Consolidated Vultee Aircraft Corporation** . . . A contract has been awarded by the U.S. Air Force calling for the "further development" of a new high-performance interceptor aircraft. According to the present contract, the work will involve only wind-tunnel studies and mock-up construction . . . A new $2,658,000 Engineering Development Center, a three-story affair measuring 210 ft. by 375 ft., is being erected on Lindbergh Field in San Diego and is scheduled for completion sometime this month. Space will be provided in the building's 225,700 sq.ft. of floor area for Design Engineering Section, including aerodynamics, hydrodynamics, thermodynamics, hydraulics, and other groups. An Electronics Guidance Section, Research Laboratory, Instrumentation Laboratory, and a Radar Testing Section will also be included in the new Center.

• **Continental Motors Corporation** . . . The exclusive manufacturing rights in the United States to a series of nine turbine engines of the Société Turboméca, French manufacturer of turbines and compressors, have been purchased. This series of nine engines includes: two air-generator types, the Pimedon and Palouste; two shaft-turbine types, Artouste I and Artouste II; three jet types, Pimene, Palas, and Marbore II; and two ducted- fan types, Aspin I and Aspin II. The initial production of these engines will be done by Continental Aviation and Engineering Corporation, a subsidiary of Continental Motors.

• **Cornell University** . . . Dean W. Malott was installed on September 19 as the sixth President of Cornell. Mr. Malott was formerly Chancellor of the University of Kansas for 12 years.

• **Curtiss-Wright Corporation** . . . Paul V. Shields has tendered his resignation as Chairman of the Board in accordance with his original agreement with the corporation when he assumed that position in April, 1949. Curtiss-Wright President Roy T. Hurley will assume the duties of Chairman in addition to his present ones. Mr. Shields will remain on until the end of 1951.

• **Douglas Aircraft Company, Inc.** . . . An Air Force approval has been received for a three-story electronics testing laboratory, measuring 80 by 221 ft., to be constructed in Tulsa, Okla. To be built of reinforced concrete, the structure is scheduled for completion by February 1, 1952. . . . The Navy has taken delivery on three of the

first military versions of the DC-6A Liftmaster, designated by the Navy as the R6D-1.

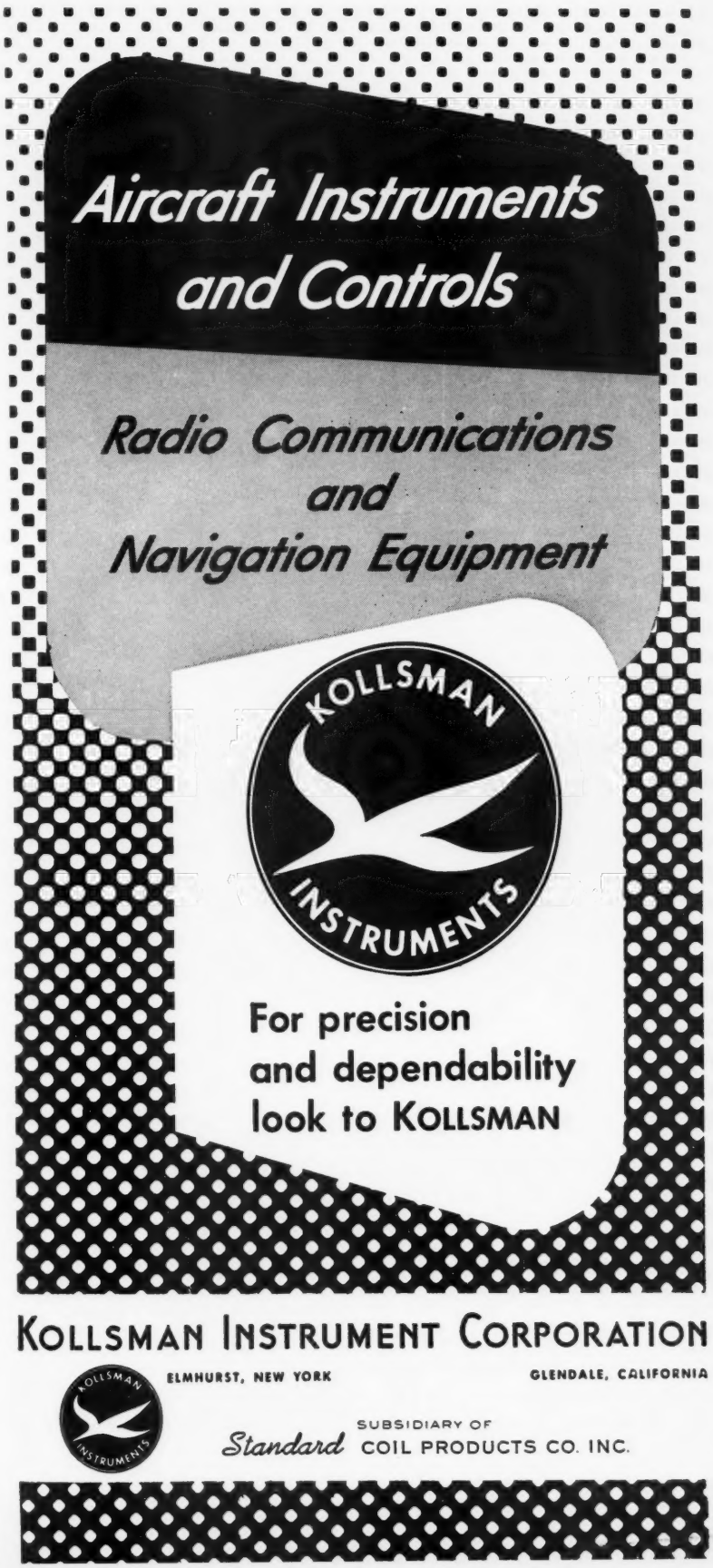
• **Eaton Manufacturing Company** . . . W. H. Wallace, General Manager, died recently. He is succeeded in this position by F. I. Goodrich.

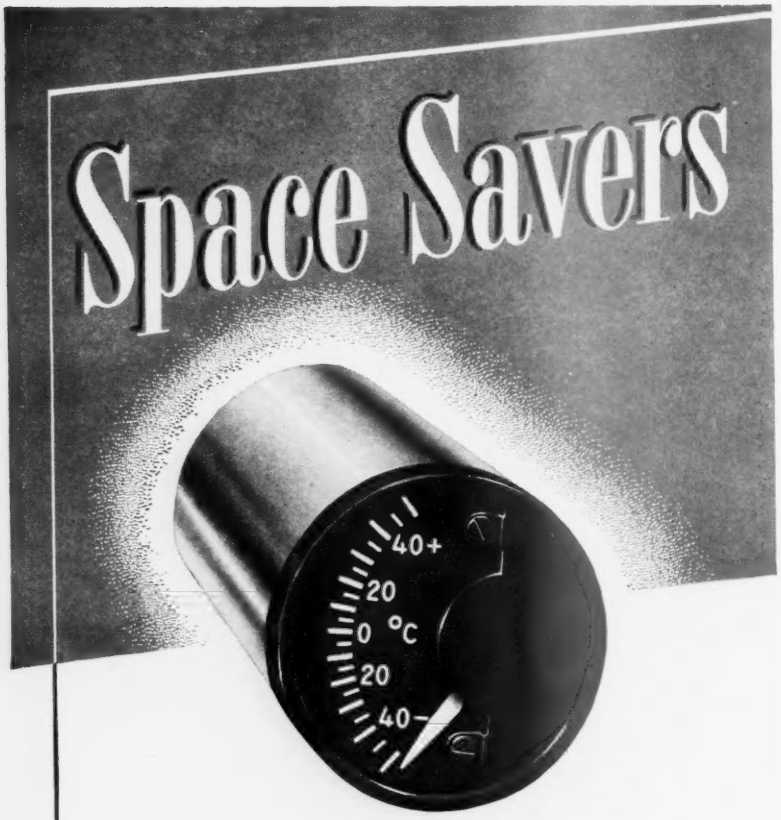
• **Federal Telecommunication Laboratories, Inc., Federal Telephone and Radio Corporation** . . . Airborne Distance Measuring Equipments are being delivered to the C.A.A.

• **General Electric Company** . . . The six new operating divisions are: Turbine Division, Schenectady, N.Y.; Motor and Generator Division, Schenectady; Transformer and Allied Products Division, Pittsfield, Mass.; Measurements and Industrial Products Division, Lynn, Mass.; Switchgear and Control Division, Philadelphia; and Component Products Division, Fort Wayne, Ind. . . Two new Vice-Presidents of the company were recently elected. They are: John W. Belanger, of Schenectady, who is General Manager of G-E's newly created Defense Production Division, and Nicholas M. DuChemin, of New York, who was recently placed in charge of the Manufacturing Services Division . . . Sam Littlejohn, who was recently elected Commercial Vice-President, is in charge of customer relations activities with headquarters in Cleveland . . . A new two-color booklet, designated as Bulletin GEC-808, is available on G-E Tantalytic capacitors.

• **Hamilton Standard Division, United Aircraft Corporation** . . . A new line of turbine-engine starters has been announced which substantially reduce the time required for starting turbine power plants. These new products are said to be considerably lighter than the electrical equipment currently in use and deliver many times its horsepower.

• **Lockheed Aircraft Corporation** . . . Research and manufacturing engineers at Lockheed recently unveiled what is believed to be the largest single piece of aircraft wing ever made. It is a self-stiffened 32- by 4-ft. panel that has been designed for the wing of the Super Constellation transport. This 323-lb. aluminum-alloy strip, which was cut out of a 900-lb. solid slab, represented a saving of much time and money and is described as the start of a new school of airplane design. Each panel will replace complicated assemblies composed of about 1,500 different parts; each will eliminate about 5,000 rivets. As soon as new tooling for revised assembly methods is completed, this 32-ft.-long wing piece will be mass-produced on the new $400,000 skin mill . . . Fixed plans for a $2,500,000 50-passenger all-jet transport capable of regular nonstop transatlantic flight have been announced. Production of this proposed jet transport will proceed upon receipt of orders from the air lines and the military. . . The military version of the recently announced 5-cent-a-ton-mile all-cargo Super Constellation (see the November, 1951, AERONAUTICAL ENGINEERING REVIEW) has been designated the R70-1 by the Navy and the C-121C by the Air Force. This new convertible military supply plane will be used to transport cargo, passengers, or battle casualties. . . Assemblies for the Super Constellation are





Engine Instruments by WESTON

Meet the latest military specifications. Hermetically sealed, and with flanges eliminated to conserve panel space. Quickly mounted by simple clamping method. Available as Temperature Instruments for latest aircraft requirements. Weston Electrical Instrument Corporation, 575 Frelinghuysen Avenue, Newark 5, N. J., manufacturers of Weston and TAGliabue instruments.

Other WESTON instruments for aviation service include:

ILS Cross Pointer Indicators—Position Indicators—Special Flight Instruments—Ammeters, Voltmeters and Frequency Meters—Complete electrical and electronic Test Equipment

WESTON
Aircraft Instruments

to be produced in the new plant recently leased in Bakersfield, Calif. . . . A newly erected building in North Hollywood, Calif., has been leased for the purpose of conducting indoctrination classes for new employees.

• **Lockheed Aircraft Service, Inc., Subsidiary of Lockheed Aircraft Corporation** . . . A new warehouse containing 9,000 sq.-ft. has been opened at the aircraft maintenance and overhaul base in Burbank, Calif.

• **The Glenn L. Martin Company** . . . A 7,000-ton hydraulic press has been purchased for use in low-pressure shallow metal forming by the Guerin process. Delivery is expected soon on a Marform press, probably a 6,500-ton job, from Hydropress, Inc. Martin already owns two Marform presses, one with a 3,500-ton capacity and the other with an 800-ton capacity.

• **McDonnell Aircraft Corporation** . . . A helicopter design using a single three-bladed rotor driven by small jet engines on the blade tips won for the company a contract from the Navy to build a jet-powered "cargo unloader" type helicopter. The proposed helicopter will have powerful winch equipment and retractable cargo sling and is also designed to airlift cargo pods. This design was one of those submitted in competition for a ship-based helicopter capable of transferring heavy equipment to other ships or to combat units ashore under all weather conditions . . . The Board of Directors has authorized a $17,513,486 facilities program. Of this amount, $9,873,093 is for the acquisition of the main portion of the plant at the Lambert-St. Louis Municipal Airport, which was purchased from the City of St. Louis last July 31. A total of $3,500,000 has been authorized for a new flight-test hangar, and $2,000,000 has been earmarked for a wind-tunnel program . . . The latest model twin-jet Banshee, the F2H-3, is now undergoing quantity production for the U.S. Navy. Deliveries are scheduled to begin in the 1952 fiscal year . . . William R. Orthwein, Jr., Manager, Personnel Division, was elected a member of the Board of Directors.

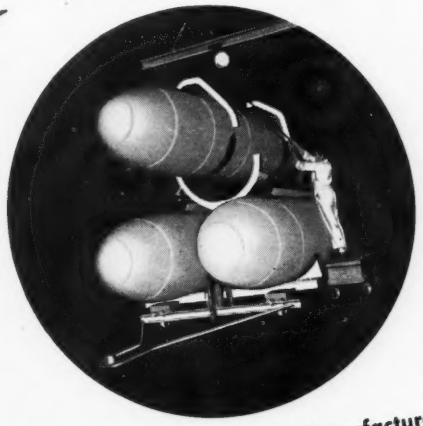
• **McDonnell Aircraft Corporation and Goodyear Aircraft Corporation of The Goodyear Tire & Rubber Company** . . . Both companies have been awarded prime contracts to produce the Navy jet fighter, the McDonnell F3H-1 Demon. Goodyear will produce the fighter at its Akron, Ohio, plant under terms of a licensing agreement with McDonnell; the McDonnell production will take place at its St. Louis plant.

• **North American Aviation, Inc.** . . . Renovations of facilities at the Fresno (Calif.) Air Terminal were resumed in late September after several months' delay and were scheduled for completion within 30 days of that time. North American's lease with the City of Fresno covers about 130,000 sq.ft. of hangar, shop, and floor space and provides an option for an additional 50,000 sq.ft. of floor space, if required, at a later date. The 130,000 sq.ft. will be used primarily for a military modernization program under contract with the U.S.A.F.

RYAN BRACKETS THE AIRCRAFT FIELD

Ryan
SINCE 1922

AIRCRAFT and AERONAUTICAL PRODUCTS



Airframe Components Manufacture and Navion Executive-Liaison Airplanes

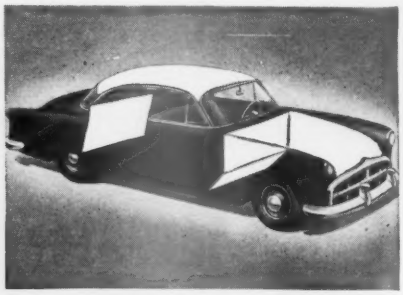
Electronics Research and Development

Pilotless Aircraft and Jet Propulsion Research

Ryan activities bracket many fields ranging from development of subminiature electronic equipment to manufacture of huge external fuel tanks and fuselage sections . . . from executive-liaison planes to high-speed pilotless jet aircraft and new applications of jet propulsion.

RYAN AERONAUTICAL COMPANY
LINDBERGH FIELD, SAN DIEGO, CALIFORNIA

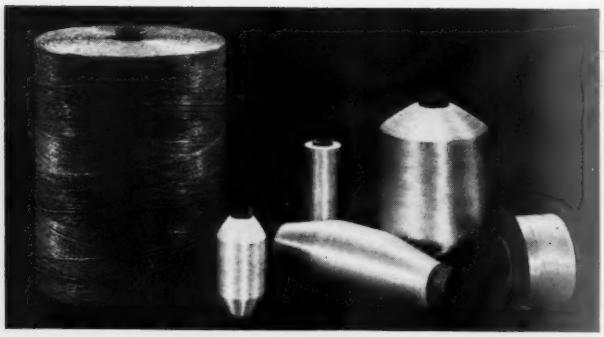
Automobile tops, insulated with L·O·F Fiber·Glass against heat and cold, increase passenger comfort. Easy installation. Light weight. Won't deteriorate under normal conditions.



Automobile sound insulation a made-to-order job for L·O·F Fiber·Glass. Easy installation in doors, under the dash, on the fire wall, under the hood. Low moisture absorption, light weight.

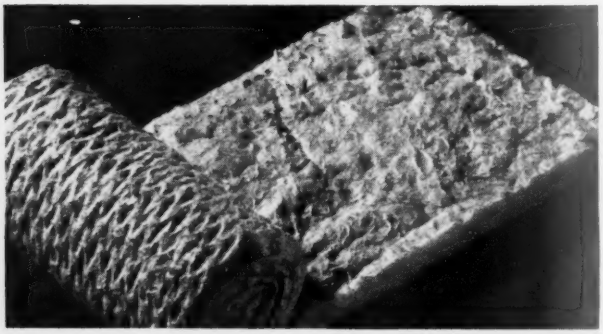
Aircraft sound and thermal insulation. Get these advantages of L·O·F Fiber·Glass. Light weight (as low as .3 lb. per cu. ft.). High fire safety. Low moisture pickup. High sound-insulating efficiency.

Proven glass technology plus fir
now devoted to early production of

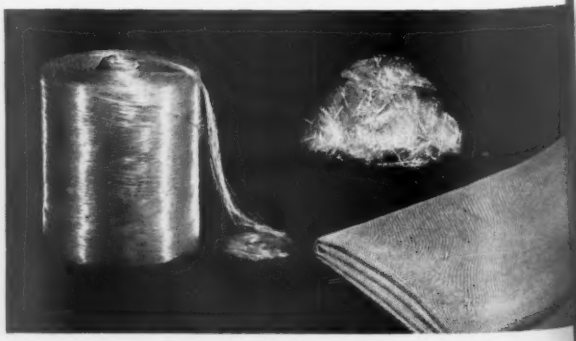


Continuous Fiber Textile Yarn—150 series for many uses, such as electrical insulating tape, sleeving, cloth, roving, and paper reinforcement. Glass fibers have enormous tensile strength . . . 250 thousand pounds per square inch. High dielectric strength. Withstands temperatures up to 800°F.

Super·Fine "B" Fiber—Splendid thermal- and sound-insulating qualities. Fiber diameter, .00012″. Temperature range -0°F. to plus 450°F. Standard roll widths, 18″, 24″, 36″, 72″, in 100′ and 200′ lengths. Other widths and lengths also available in a range of thicknesses and densities.

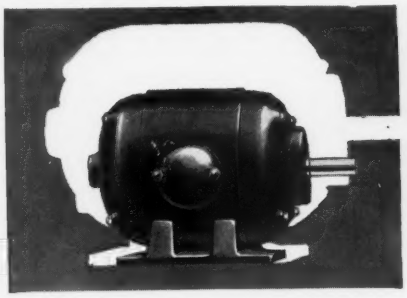


Super·Fine "AA" Fiber—primarily for aircraft insulation. Thickness, .5″ with density of .6 lb. per cu. ft. Fibers of incredibly small diameter—.00004″. With plastic binder to hold dimensional form. Roll widths, 36″, 72″, in 50′ standard length.

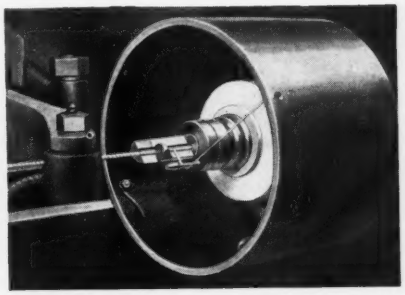


Roving, Chopped Strand and Textile Yarns—for reinforcing of plastics, paper, cloth and paper tape, etc. Enormous tensile strength. Won't shrink or stretch. Won't deteriorate under normal conditions. Versatile in application.

Industrial fabrics woven from Fiber·Glass are fine, safe, strong, rot- and mildew-proof. Ideal applications are tarpaulins, flame shields, airplane cloth, reinforcement for plastics.



Electric motors and generators insulated with L·O·F Fiber·Glass withstand heavy overloads. Appreciable space factor advantages! High dielectric strength.



Wire and cable can be served directly with L·O·F Fiber·Glass textile yarns using standard machines. Yarn also ideal for weaving tape, and braiding on wire and into sleeving.

fine, new facilities of L·O·F FIBER·GLASS!

Aviation, automotive, textile and electrical industries first to benefit from new, high-quality source of supply being readied by Libbey•Owens•Ford

HERE IS headline news of *immediate* interest to key men of business and industry.

The resources and advanced technical glass knowledge of Libbey·Owens·Ford are being focused on a new product—L·O·F Fiber·Glass!

With fine, new facilities at Parkersburg, W. Va., placed to serve you quickly, glass technicians of proven ability and experience are getting set to produce top-quality Fiber·Glass products in volume. (See facing page for basic items to be produced. Note above and right for typical applications.)

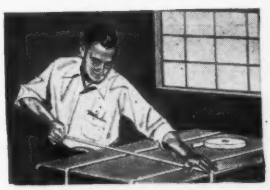
Across the country, in 24 major cities, L·O·F offices are busy with preparations to give you help on specific uses.

If your company has already discovered the superior qualities of fibrous glass, investigate L·O·F now as a new volume source, worthy of your complete confidence.

If your company now buys other material for electrical insulation, thermal or acoustical insulation, or reinforcing for plastics or paper, L·O·F Fiber·Glass can offer a combination of advantages unmatched by such other materials. This is a chance to benefit from the glass technology and the high standard of quality which you have come to expect from L·O·F!

For technical data, or engineering consultation on Fiber·Glass uses in your business, call your local L·O·F office—or write, wire or phone Libbey·Owens·Ford, Dept. F·G 109, Nicholas Bldg., Toledo 3, Ohio.

Plastic reinforcing, as in this bread tote tray, presents many possibilities with L·O·F Fiber·Glass. Remarkable strength. Won't dent or lose shape. No discoloration of plastic material. Exceptionally long life.



Paper and paper tape reinforced with L·O·F Fiber·Glass can be raised in tensile strength to equal aluminum or even steel! Either Fiber·Glass textile yarns or scrim mesh are suitable. Investigate!

LIBBEY·OWENS·FORD GLASS COMPANY
FIBER·GLASS DIVISION

L O F
FIBER·GLASS

FIBER·GLASS

• **Northrop Aircraft, Inc.** . . . The sideslip stability augmenter, a device that makes use of dynamic rather than static control surfaces to provide stability, has been developed as a new approach to the problems of aerodynamic stability and control. The augmenter employs an extremely low threshold accelerometer to measure side force on the aircraft and, by means of an electrical servosystem, apparently deflects the rudder to neutralize the side force. An important characteristic of the device is that dynamic lateral stability many times greater than normal is available with no loss in controllability . . . A new automatic landing approach flight simulator has been developed by Northrop engineers. This device, which duplicates for classroom use the flight of a Northrop F-89 Scorpion during automatic ground-approach procedure, was developed to simplify the training of U.S.A.F. ground personnel in the maintenance of automatic approach equipment . . . A production flight and installation center is under construction at Palmdale, Calif., and will be operated by Northrop for the U.S. Air Force. This facility, which is expected to be in operation sometime after mid-1952, will permit the expansion of work now performed at Northrop's leased space at Ontario International Airport, Calif. . . A new test base for guided missile activities is being established by the company at the U.S.A.F.'s Long Range Proving Ground at Cocoa, Fla.

• **Pan American World Airways, Inc.** . . . Alvin P. Adams, who was formerly head of the aviation management consulting firm of Alvin P. Adams & Associates, was elected a Vice-President of Pan American by the action of the Board of Directors. Mr. Adams assumes the duties and responsibilities of Adm. John H. Towers, U.S.N. (Ret.), A.F.I.A.S., who will soon reach the retirement age.

• **The Parker Appliance Company** . . . R. W. Cornell, Vice-President in Charge of Manufacturing, was elected to the Board of Directors . . . Now available is Catalog 5400 that describes twelve different compounds for thread sealing and valve lubrication.

• **Pratt & Whitney Aircraft Division, United Aircraft Corporation** . . . The J-42 Turbo-Wasp is said to be the first jet aircraft engine to reach an officially authorized service life of 1,000 hours between major overhauls.

• **Republic Aviation Corporation** . . . The U.S. Air Force has awarded a contract to Republic for the "further development" of a new high-performance interceptor airplane. Only the wind-tunnel studies and mock-up construction are involved in this present contract.

• **Servomechanisms, Inc.** . . . An 18,000-sq.ft. plant has been leased at Broward County Airport, Fort Lauderdale, Fla., and is to be used for the production of airborne electronic equipment.

• **Shell Oil Company, Inc.** . . . A new aviation gasoline ingredient has been developed for which the virtual elimination of spark plug fouling and the consequent increase in aircraft safety and efficiency are indicated. This additive is said to reduce the fouling by changing the nature of the deposit in the spark plug in such a manner that the plug does not become conductive in its insulated parts. This new product, however, is still under evaluation, and the final quantitative results cannot be definitely stated until the conclusion of extensive flight testing . . . A new product to provide rust and corrosion proofing without coatings is offered by "VPI" crystals, an amine nitrate, now being made available to industry. Being slightly volatile at atmospheric temperatures, VPI gives off vapors that are carried by convection and diffusion to all surfaces of the metal, where they condense to form a thin protective layer. This new corrosion preventative is intended to protect metal parts, assemblies, instruments, and finished products during shipments, storage, and through the various processing steps. One gram of VPI is said to protect a cubic foot of metal surface, or parts, for up to one year when properly used with a barrier to prevent loss of vapor.

• **Simmonds Aerocessories, Inc.** . . . As part of the expansion of activities relating to the design and manufacture of specialized aircraft and engineering equipment, Howard Holmes was elected Vice-President and General Manager of Development and Contracts and M. I. Benton was elected Vice-President and General Manager of Manufacturing Operations in the Vergennes, Vt., area. Messrs. Holmes and Benton will be headquartered in Tarrytown, N.Y., and Vergennes, respectively.

• **Solar Aircraft Company** . . . A new jet-engine parts plant was dedicated on October 14 at Des Moines, Iowa. Hot end parts for the latest jet engines will be manufactured in the new Wakonda plant . . . A new 40-page catalog that contains over 78,000 possible combinations of bellows-type expansion joints is available gratis from Solar. This booklet, Catalog No. 51, serves as a reference handbook and illustrates a diversified line of standard and special bellows assemblies used to take up expansion, contraction, and offset movements in pipes and conduits. It is entitled *Industrial Expansion Joints and Aircraft Bellows.*

• **Sperry Gyroscope Company, Division of The Sperry Corporation** . . . Now in production is a new portable engine analyzer that electronically detects, locates, and identifies detailed ignition and mechanical troubles in power plants containing any number of cylinders. The principal feature of this new analyzer, which is designed for high-altitude airborne use as well as ground use, is a new timing adjustment that makes setting of the timing generator on the engine unnecessary. The operator, by turning a knob shaft on the instrument panel, can synchronize the analyzer accurately to any angle of the engine's rotating crankshaft.

• **Standard Oil Company (Indiana)** . . . Dwight F. Benton was elected to the position of Vice-President in Charge of Sales. Mr. Benton succeeds R. F. Baity who died on September 30.

• **Thompson Products, Inc.** . . . Brigadier General Horace A. Shepard, U.S.A.F. (Ret.), is now Vice-President of the company.

• **Trans World Airlines, Inc.** . . . John A. Collings has been moved up from Vice-President in Charge of Operations to Executive Vice-President. David W. Harris and Gordon Gilmore were elected Vice-President of Industrial Relations and Vice-President of Public Relations, respectively . . . Sales offices have been opened in Nice, France, and Llanes, Spain.

• **United Air Lines, Inc.** . . . The following changes in the top positions were recently made: J. A. Herlihy, M.I.A.S., from Vice-President—Operations to Vice-President—Engineering and Maintenance; D. R. Petty, from Flight Supervisor to Vice-President—Flight Operations; and D. F. Magarrell, from Vice-President—Passenger Service to Vice-President—Transportation Services.

• **Westinghouse Electric Corporation** . . . A $296,000,000 expansion program, aimed at increasing the productive capacity by 50 per cent, has been announced and is scheduled to carry into 1953. This will be the second expansion program since the end of World War II. Part of the new expansion program has already been undertaken; it includes a plant in Raritan Township, N.J., for electronic equipment; a small motor plant at Union City, Ind.; an aircraft-armament plant in Baltimore, Md.; and a jet-engine plant at Columbus, Ohio.

Student Branches

Academy of Aeronautics

Chairman Bernard Buc opened the July 25 meeting, which was attended by 29 persons for the purpose of electing new officers. The following were elected at that time: Chairman, Calvin D. Holbert; Vice-Chairman, Nicholas G. Kruger; Secretary, Vasant D. Wagle; Corresponding Secretary, Floyd D. Lynn; and Treasurer, Edward R. Rode.

Frank Negro received last year's I.A.S. lecture award. His subject was "The Theory of Jet Engines." The I.A.S. award for the highest scholastic standing in the graduating class went to Warren Baur.

Agricultural and Mechanical College of Texas

E. E. Brush, Faculty Adviser, presided over the election of officers at the September 26 meeting at which 42 students were present. The following officers were elected: Chairman, Richard T. Cliffe; Vice-Chairman,

Light in weight, compact and highly efficient, the new Harrison air-to-oil aluminum plate-type cooler is designed for a variety of aircraft applications.

New Oil Cooler BY HARRISON

The new oil-cooler, with a test pressure of 400 pounds per square inch, can be designed to fit almost any available space. It can be used to cool the oil used in air-compressors and turbines of turbo-prop engines . . . the fluid in hydraulic systems . . . or the engine bearing oil in helicopters, for example. Thermostatic control permits oil to by-pass the cooler until predetermined temperatures are reached.

We invite inquiries from airframe and engine manufacturers.

Aluminum Plate-Type Unit Designed for Aircraft

HARRISON

HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK

Jack E. Cayot; Secretary, Arthur P. Goldberg; and Treasurer, James B. Kyser. The meeting was closed by the incoming Chairman, Richard T. Cliffe.

Georgia Institute of Technology

The following officers were installed at the September 28 meeting: Chairman, George Norman; Vice-Chairman, David Bernstein; Secretary, Thomas M. Perkins; and Treasurer, William T. Schleich. Thirty persons were present. The meeting was closed by the showing of a film, *Why We Fight.*

Indiana Technical College

The new officers installed at the September 18 meeting were: Chairman, John Whitehurst; Vice-Chairman, George Greeneberg; Treasurer, LaVerne Pond; and Secretary, Roger Kauffman. Two films, *Winning Your Wings* and *Pacific Milk Run,* were shown. Chairman John Whitehurst presided; 19 persons were present.

Chairman Whitehurst led the October 2 meeting at which 20 persons were in attendance. Nat Kobitz was named the Outstanding Student in the Aeronautical Department for the 1951 Summer Term. Two films, *Nature Plays Favorites* and *Pylon Dusters,* were shown.

Massachusetts Institute of Technology

At the October 4 meeting, a film entitled *Helioplane Courier* was shown. Chairman Alfred Blackburn presided; 29 persons were present.

Parks College of Aeronautical Technology

Chairman Lawrence Reitmeyer opened the September 12 meeting at which an election of officers took place with the following results: Chairman, Joseph Witko; Vice-Chairman, Robert Ringel; Treasurer, Richard Morgan; Recording Secretary, Peter Soule; and Corresponding Secretary, Eugene Swick. After the elections, the meeting was turned over to the newly elected Chairman, Joseph Witko, who introduced the speaker, Howard Scott, Graduating Engineer, Parks College. Mr. Scott presented a paper on "Stresscoat" to the 25 persons who were in attendance. The meeting was ended by the showing of a film entitled *NACA Research.*

University of Notre Dame

The first meeting of the 1951–1952 year was called to order on September 20 by Chairman Peter Skerret with 33 persons present. The showing of a film, *Record of Flight,* concluded the meeting.

Rensselaer Polytechnic Institute

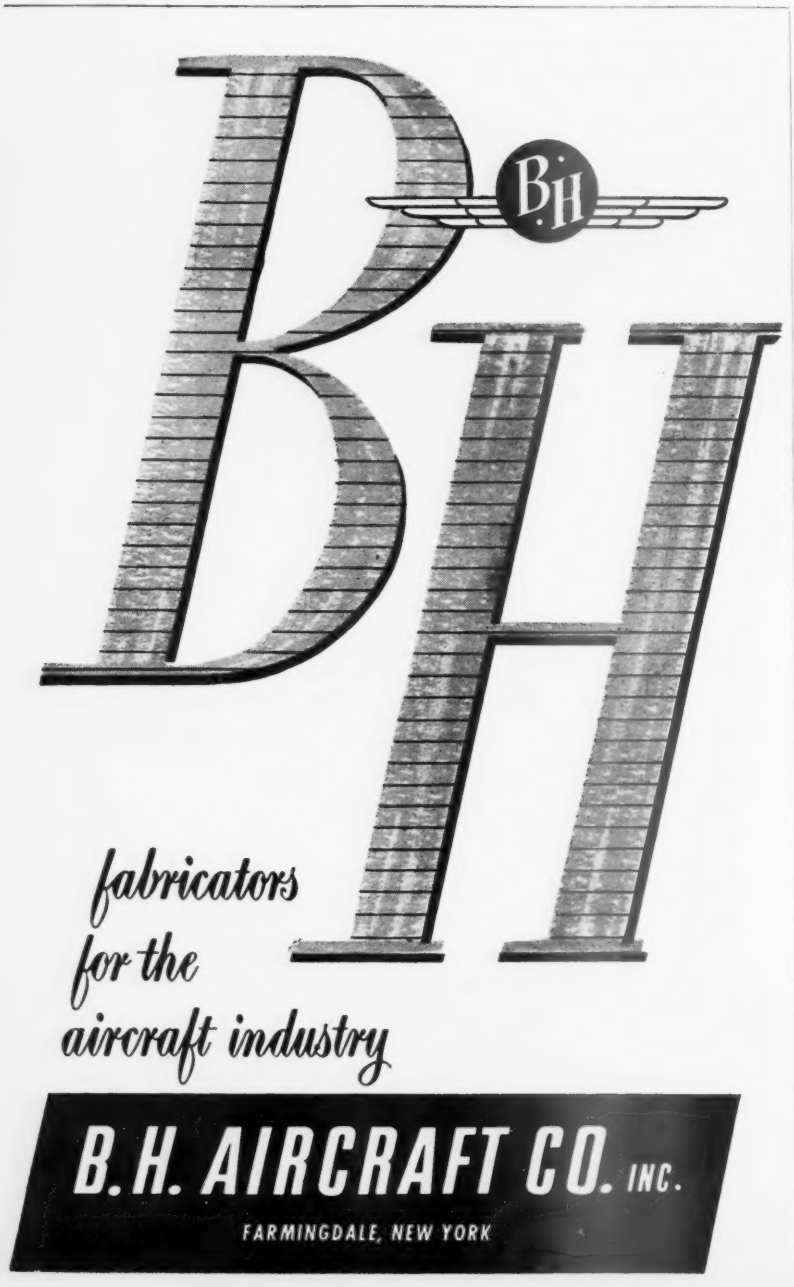
Lieutenant Colonel R. H. Fitzgerald, U.S.A.F., Head, Aircraft Maintenance Engineering, Atlantic Division, Military Air Transport Service, was the guest speaker at the September 19 meeting. Colonel Fitzgerald spoke on "Engineering and Operational Problems of the Military Air Transport Service." Dr. R. P. Harrington, Head, Aeronautical Engineering Department, R.P.I., gave an introductory talk on the history of the I.A.S. An Air Force film, *G.C.A.,* was shown. Chairman Jack Williams presided; 65 persons attended.

University of Tulsa

J. Charles Klotz, Professor of Aeronautical Engineering, Tulsa, spoke to the 24 persons attending the September 13 meeting on the subject, "Advantages and Privileges Offered to Student Members of I.A.S." Chairman Everett W. Garrison presided.

United States Naval Academy

An estimated 30 persons attended the first meeting of the 1951–1952



Maxim-built... in 1894

Designed and developed by Sir Hiram Stevens Maxim, this machine actually got off the ground on July 31, 1894, traveling 500 yards and reaching a maximum speed of 45 miles per hour. Each of the two 17 ft. propellers was driven by a 150 H.P. *steam engine*. With a wing surface of 5400 square feet, the total weight of the machine including 600 lbs. of water and 200 lbs. of naphtha, was 8000 lbs. A copy of the rare photograph above (without any advertising message) will be sent on request.

The Maxim interest in aviation has continued to this very day. At right is shown a Maxim Silencer eliminating the roar of a jet engine during run-up tests at the Lockheed plant in Burbank, California. If you have a problem of silencing you will save time and money by consulting our engineering and research departments.

Consult

MAXIM

DR. SHUSH

THE MAXIM SILENCER COMPANY
77 HOMESTEAD AVE., HARTFORD 1, CONN. —DEPT. WL

Gentlemen: ☐ Please send me more information on jet engine silencing.
☐ Please send me a copy of the early airplane photo.

NAME_____

COMPANY_____

ADDRESS_____

17MXB1

academic year, which was held on September 14 and was presided over by Vice-Chairman Charles H. Kruse, Midshipman, s/c, U.S.N. A Navy film from the Bureau of Aeronautics, *History of Naval Aviation*, was screened.

Chairman James S. McNeely, Midshipman 1/c, U.S.N., presided at the September 21 meeting at which the film, *Air Power Is Peace Power*, was shown. Thirty-six persons were present.

Commander Lafferty, U.S.N., Faculty Adviser, spoke to the 39 students attending the September 28 meeting. A U.S.N. Bureau of Aeronautics film, *The History of Guided Missiles*, was shown. Chairman McNeely presided.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Elected to Associate Fellow Grade

Warren, Charles H. E., M.A., Principal Scientific Officer, Royal Aircraft Establishment.

Transferred to Associate Fellow Grade

Bullock, Robert O., B.S. in E.E., Asst. Chief, Compressor & Turbine Research Div., Lewis Flight Propulsion Lab., N.A.C.A.

Collins, John H., Jr., B.S. in M.E., Asst. Chief of Research for Coordination & Liaison, Lewis Flight Propulsion Lab., N.A.C.A.

Ellerbrock, Herman H., Jr., B. of Engrg., Aero. Research Scientist, Compressors & Turbines, Lewis Flight Propulsion Lab., N.A.C.A.

Halperin, Eugene, Senior Project Engineer & Asst. Section Head, Special Devices Center, Office of Naval Research.

Manganiello, Eugene J., E.E., Asst. Chief of Research, Lewis Flight Propulsion Lab., N.A.C.A.

Rodert, Lewis A., B. of Ae.E., Aero. Research Scientist, Special Projects, Lewis Flight Propulsion Lab., N.A.C.A.

Wilson, Herbert A., Jr., B.S. in Ae.E., Head, Unitary Plan Design Group, N.A.C.A., Langley Air Force Base.

Elected to MEMBER Grade

Amster, Warren, A. E., Stability Engineer, Gibbs & Cox, Inc.

Barr, LeRoy H., Asst. Chief Engineer, Complete charge of Engineering Dept., Experimental Machine Shop & Test Lab., Romec Div., Lear, Inc.

Cannon, Robert H., Jr., Sc.D., Research Engineer, Aerophysics Lab., North American Aviation Inc.

Harding, George A., B.S. in Physics, Projects Officer, Aerophysics Lab., North American Aviation, Inc.

Hauser, Cavour H., M.S.M.E., Aero. Research Scientist III, Lewis Flight Propulsion Lab., N.A.C.A.

Heywood, Charles, Chief Service Engineer, Elastic Stop Nut Corp.

Houska, Robert W., B.M.E., Asst. Project Engineer, Research Div., Wright Aero. Corp. Div. of Curtiss-Wright Corp.

Jackson, Arthur V., B.S., Major, U.S.A.F.; Air Technical Intelligence Specialist, Intelligence Dept., Hq., Air Materiel Command.

Kronberg, Bernard, Flight Test Engineer (Technical Staff), North American Aviation, Inc.

LaPierre, Cramer W., Mgr., Aircraft Gas Turbine Div., General Electric Co. (W. Lynn).

Lippis, Rocco, B. S., Chief, Aircraft Engineering Branch, C.A.A. (Los Angeles).

McFarland, H. W., A.B., Chief, Propulsion Section, Aero. Lab., University of Southern California.

Ryan, Lloyd F., Dr. Sc. Techn., Lt. Colonel, U.S.A.F.; Chief, Association Equipment Section, Intelligence Dept., Hqs. Air Materiel Command, Wright-Patterson Air Force Base.

Smallberg, Merle, B.S.

Walker, DeMelt E., M.S., Major, U.S.A.F.E; Air Technical Liaison Officer, Hq., Air Materiel Command.

Walker, Howell L., Jr., B.S.M.E., Design Engineer, Douglas Aircraft Co., Inc.; presently assigned to Oak Ridge School of Reactor Technology.

Wall, Ernest, M.A.Sc., Project Mgr., PSC Applied Research, Ltd. (Toronto).

Transferred to MEMBER Grade

Cooley, William C., Sc.D., in M.E., Research Engineer "A," Atomic Energy Research Dept., North American Aviation, Inc.

Diehl, Zulime W., A.B., Physicist (Aerodynamicist), National Bureau of Standards (Washington, D.C.).

Goland, Leonard, M. of Ae.E., Project Engineer, Reaction Motors, Inc.

Gossick, Lee V., M.S., Lt. Colonel, U.S.A.F.; Staff Coordinating Officer, Chief, Tactical Air Research Branch, Hdq. Air Research & Development Command (Baltimore).

Hoffstetter, Robert U., B. of Ae.E., Aero. Research Scientist, Ames Aero. Lab., N.A.C.A.

Kraus, Samuel, M. of Ae.E., Aero. Research Scientist, Ames Aero. Lab., N.A.C.A.

Lang, Arthur L., Jr., M. of Ae.E., Senior Project Analytical Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Larrabee, Elmer E., S.M., Professor, Massachusetts Institute of Technology.

Matteson, Frederick H., M.S.M.E., Aero. Research Scientist, Aerodynamics, Ames Aero. Lab., N.A.C.A.

Merrill, Ralph L., M.S. in M.E., Engineering Designer "B," Armament Design Group, Douglas Aircraft Co., Inc. (El Segundo).

Nay, Harvey O., M.S. (Aero.), Aerodynamics Engineer "A," Douglas Aircraft Co., Inc. (El Segundo).

Oakes, William J., Jr., M.S. in Ae.E., Aerodynamics Engineer, Consolidated Vultee Aircraft Corp. (San Diego).

Pearson, Chas.-Robt., M.S.E. (Aero.), Engineer, Service Dept., Physical Research Unit, Boeing Airplane Co. (Seattle).

Pedersen, Paul E., B.S.Ae.E., Research Engineer, Cook Research Labs., Field Test Section, Edwards Air Force Base (Muroc).

Schwartz, Martin De Puy, Sc.D. in Ae.E., Senior Engineer, Project Leader in Aero-Elastic & Structures, Research Dept., Massachusetts Institute of Technology.

Smith, Robert H., B.S. in Ae.E., Jr. Research Engineer, University of Washington.

Stephens, Uel, Jr., B.S., Structures Engineer, Consolidated Vultee Aircraft Corp. (Fort Worth).

Van Meter, James T., M.S., Analytical Research Engineer, Research Dept., United Aircraft Corp.

Elected to Associate Member Grade

Baldwin, Harry M., General Foreman, Bridgeport-Lycoming Div., Avco Mfg. Corp.

Dzik, Stanley J., Chief Engineer & Owner, Aircraft Design.

Suddes, A. H., Sales Mgr., Western Aircraft Sales & Service, Ltd.

Elected to Technical Member Grade

Armstrong, Roy, Servo Valve Technician, Engineering Dept., Servo Div., Bell Aircraft Corp.

Beverage, Allan D., B.S.M.E., Commercial Engineer, Aircraft Gas Turbines Div., General Electric Co. (Lockland).

Brandon, E. Thomas, Jr., M.S., Jr. Engineer, Development Lab., Bendix Aviation Corp. (Pacific Div.).

Elwell, Harwood C., Jr., B.S. in Engineering, Stress Analyst, North American Aviation, Inc. (Inglewood).

Grimley, Kenneth R., B.A., Squadron Leader, R.C.A.F.; Officer in charge of R.C.A.F. Maintenance Appraisal Team CF 100 at A. V. Roe Canada Ltd.

Hazen, David C., M.S., Associate Professor of Aero. Engineering, Princeton University.

Henderson, Arthur, Jr., M.S.M.E., Aero. Research Scientist, Aerodynamics II, Experimental & Theoretical Research, N.A.C.A., Langley Air Force Base.

Horvath, Stephen J., Designer, Guided Missiles Section, Douglas Aircraft Co., Inc. (Santa Monica).

Mariolis, Michael, B.S. in M.E. (Aero.).

Naras, Richard J., B.S.Ae.E., Engineers Draftsman "B," North American Aviation, Inc.

Another new development using

B. F. Goodrich Chemical Company ***raw materials***

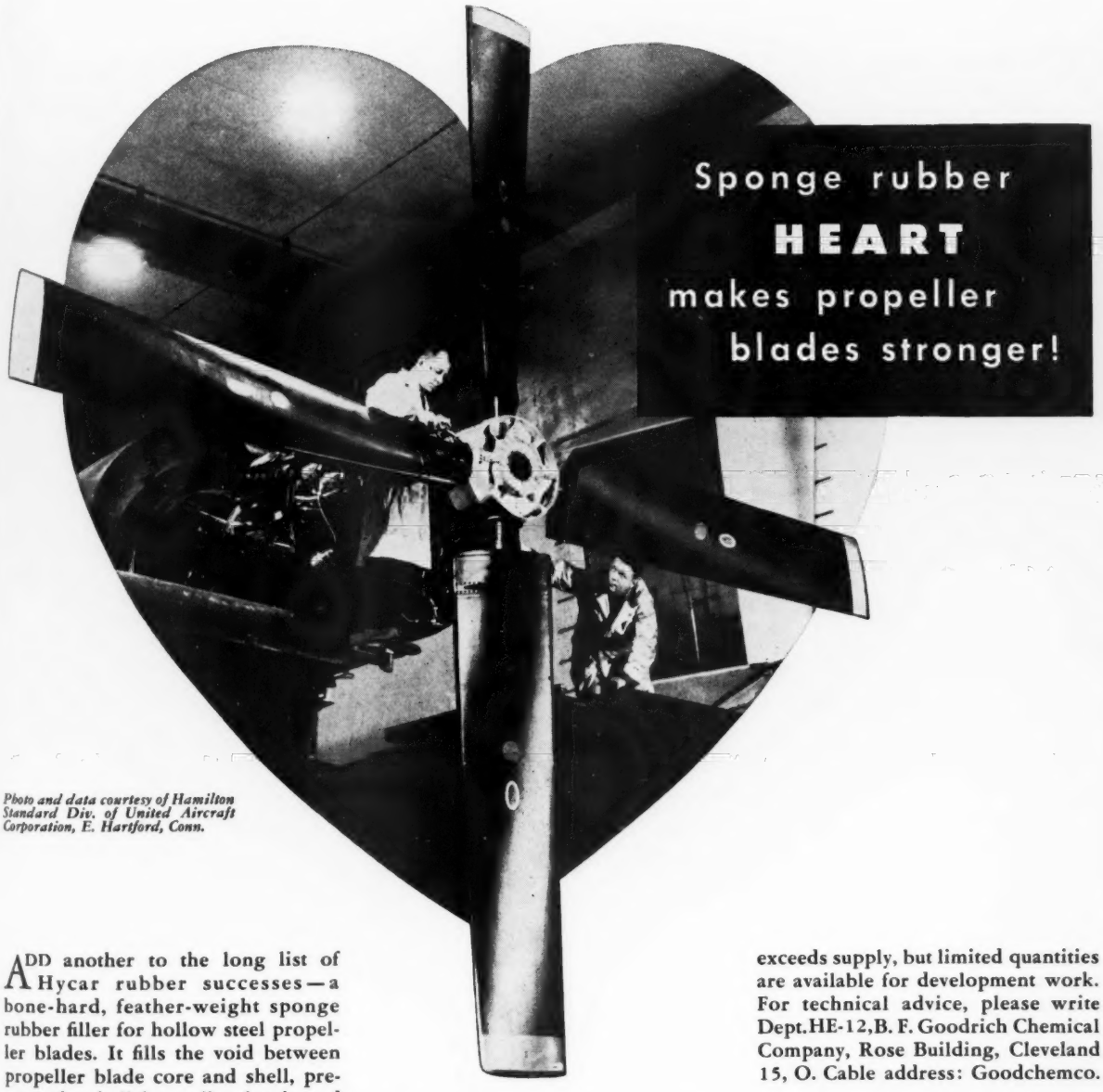


Photo and data courtesy of Hamilton Standard Div. of United Aircraft Corporation, E. Hartford, Conn.

ADD another to the long list of Hycar rubber successes—a bone-hard, feather-weight sponge rubber filler for hollow steel propeller blades. It fills the void between propeller blade core and shell, prevents the shell from vibrating in and out. It also supports the shell against the impact of rocks, ice and other material thrown up by the plane's undercarriage.

To find this filler took several years of search and tests of nearly a thousand rubber compounds. The winner contained phenolic resin, nylon, and an oil-resistant Hycar rubber compound. The presence of Hycar gives added toughness to the phenolic-nylon blend.

Hycar nitrile rubber's versatility helped make this new material possible. For Hycar has high resistance to heat, cold, cooling liquids, gas, weather and wear. It has excellent compression set characteristics, good aging properties and low moisture vapor permeability.

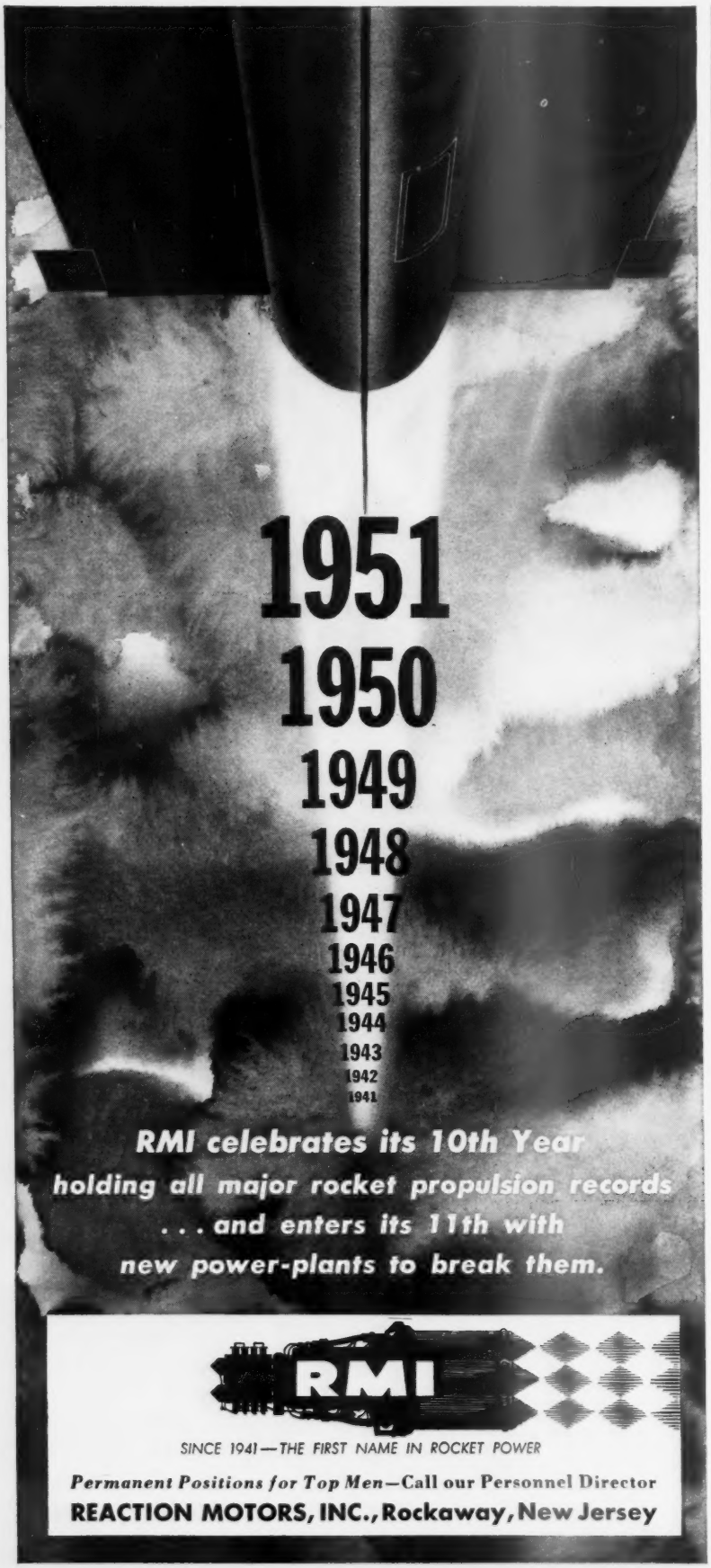
Hycar's advantages make it ideal for many civilian and defense products—in developing entirely new ones. Right now demand for Hycar exceeds supply, but limited quantities are available for development work. For technical advice, please write Dept. HE-12, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, O. Cable address: Goodchemco.

B. F. Goodrich Chemical Company
A Division of The B. F. Goodrich Company

Need extreme temperature resistance? Hycar has it—plus abrasion resistance and more advantages.

Hycar
Reg. U.S. Pat. Off.
American Rubber

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers
HARMON organic colors



Transferred to Technical Member Grade

Adams, Robert R., M.S. (Aero.), Aerodynamicist, Northrop Aircraft, Inc.

Anderson, Dale E., B.S., Technical Writer, Douglas Aircraft Co., Inc. (El Segundo).

Augustine, Ellis C., M.A.Sc., Design Engineer, A. V. Roe Canada Ltd.

Ayvazian, Mihran, S.B., Research Engineer, Struct. & Aero-Elastic Research Lab., D.I.C., Massachusetts Institute of Technology.

Baker, Harold L., B.S. in Ae.E., 2nd Lt., U.S.A.; Platoon Leader, Army Engineers (Airborne).

Barbagallo, John L., M.E., Project Engineer, Power Plant Lab., Aero. Div., A.D.C., Wright-Patterson Air Force Base.

Bauer, Andrew B., M.S., Aerodynamicist, Stability & Control Engineering, Douglas Aircraft Co., Inc. (Long Beach).

Bergst, George L., Jr., B.S. in Ae.E., Mathematician "A," Douglas Aircraft Co., Inc. (El Segundo).

Bevan, David, B.S., Jr. Aerodynamics Engineer, The Glenn L. Martin Co.

Boulware, Jesse M., B. of Ae.E., 2nd Lt., U.S.A.F.; Student Officer—Airborne Electronic Equipment, Keesler Air Force Base.

Bova, Joseph A., Engineering Draftsman "A," Propulsion Group, North American Aviation, Inc. (Downey).

Bowman, Richard M., B.Ae.E., Project Officer, Procurement Div., Air Materiel Command, Wright-Patterson Air Force Base.

Bradford, Richard G., B. of Ae.E., Test Engineer, Wright Aero. Corp. Div., Curtiss-Wright Corp.

Carter, Joseph M., M.S. in M.E., Associate Research Engineer "A," Power Plant Unit, Boeing Airplane Co. (Seattle).

Carver, George C., B.S., Jr. Production Liaison Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Clemens, Frederick J., B.S. in Ae.E., Engineering Draftsman, North American Aviation, Inc. (Columbus).

Cochrane, Frederic, B.S., Aerophysics Engineer, Stability & Control, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Criscione, Emanuel S., B.S., Aero. Research Engineer, D.I.C., Massachusetts Institute of Technology.

Daniels, Lloyd E., B.A.E., Captain, U.S.A.F.; Research & Development Project Engineer, Supersonic Wind Tunnel Div., Air Development Center, Wright-Patterson Air Force Base.

Eerkens, Jozef W., Jr.

Ellenberger, Donald L.

Elnan, Odin R. S., A.E., Structures Engineer, Aircraft Armaments, Inc.

Epperson, Thomas M., B.S. in Ae.E., Service Engineer "A," Douglas Aircraft Co., Inc. (El Segundo).

Evans, Clayton E., M.S. in Ae.E., Major, U.S.A.F.; Flight Test Engineer, Edwards Air Force Base (Muroc).

Fielding, Hunter W., Instructor, Embry Riddle School of Aviation.

Fisher, Aldon R., Jr., Liaison Engineer, Boeing Airplane Co. (Wichita).

Floyd, Atma B., Jr., B.S. in Ae.E., Design Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Forrest, Raymond D., B.S., 2nd Lt., U.S.A.F.; Asst. Aircraft Maintenance Officer, 3320th Tech. Tng. Wing, Amarillo Air Force Base.

Gebhardt, Edwin P., B.S. in Ae.E., Lt., U.S.A.F.; Analysis Engineer, Power Plant Lab., Aeronautics Div., Air Research & Development Center, Wright-Patterson Air Force Base.

Gieseman, Earl R., Jr., B.S., Captain, U.S.A.F.; Design & Development Officer, Air Development Center, Wright-Patterson Air Force Base.

Goodell, Howard C., M.S. in Ae.E., Lt. Colonel & Pilot, U.S.A.F.; Research & Development Coordinator at Field Command, Armed Forces Special Weapons Project, Sandia Base (Albuquerque).

Greene, Franklyn N., B.S. in Ae.E., Jr. Structures Engineer, The Glenn L. Martin Co.

Greiner, Herbert, B. of Ae.E., Ensign, U.S.N.R.; Hangar Deck Officer, U.S.S. Mindoro, CVE 120.

Hale, Rader O., A.E., Lt., Research & Development Officer, U.S.A.F.

Hellman, Stanley K., B.Ae.E., Test Engineer, Aviation Gas Turbine Div., General Electric Co. (Boston).

Heninger, Robert E., B. of Ae.E., Research Assoc., The Ohio State University Research Foundation.

Hill, William A., Jr., B.S., Aero. Research Intern, Ames Aero. Lab., N.A.C.A.

Hinkel, Walter A.

Hodgson, George P., B.S. in Ae.E., Engineering Trainee, Production Design Dept., The Glenn L. Martin Co.

Hoff, Russell S., Jr., A.E., Aero. Engineer in Aerodynamic Design, Wright-Patterson Air Force Base.

Hollo, George, M.E. (Aero.), Research Asst., Dept. of Aero. Engineering, Syracuse University.

Hubbard, Joel R., B.S., Jr. Engineer & Detail Designer, Power Plant Group, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Hurt, George J., Jr., B.S., Aero. Research Intern—Aerodynamics, N.A.C.A., Langley Air Force Base.

Jex, Henry R., B.S., Jr. Project Engineer, Southern California Cooperative Wind Tunnel.

Johnson, Charles A., B.S., Engineering Aide, Ramjet Design Group, Marquardt Aircraft Co.

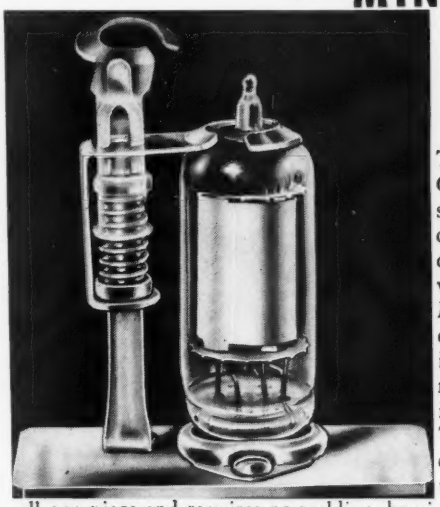
Kazlauskas, Joseph A., B.S. in Ae.E., Analytical Designer, Gas Turbines, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Kennelly, Kermit J., B. of Ae.E., Stress Analyst, New Landing Gear Design, Bendix Products Div., Bendix Aviation Corp.

Kline, Clare F., Weights Engineer, Bell Aircraft Corp.

Kokita, Woody, B.S.Ae.E., Jr. Engineer "B," Wind Tunnel, Model Design Group, Boeing Airplane Co. (Seattle).

New BIRTCHER TUBE CLAMP FOR MINIATURE TUBES



POSITIVE PROTECTION AGAINST LATERAL AND VERTICAL SHOCK!

The *New* Birtcher Type 2 Tube Clamp holds miniature tubes in their sockets under the most demanding conditions of vibration, impact and climate. Made of stainless steel and weighing less than ½ ounce, this *New* clamp for miniature tubes is easy to apply, sure in effect. The base is keyed to the chassis by a single machine screw or rivet...saving time in assembly and preventing rotation. There are no separate parts to drop or lose during assembly or during use. Birtcher Tube Clamp Type 2 is all one piece and requires no welding, brazing or soldering at any point.

If you use miniature tubes, protect them against lateral and vertical shock with the Birtcher Tube Clamp (Type 2). Write for sample and literature.

Builder of millions of stainless steel Locking Type Tube Clamps for hundreds of electronic manufacturers.

The BIRTCHER *Corporation*
5087 HUNTINGTON DRIVE • LOS ANGELES 32

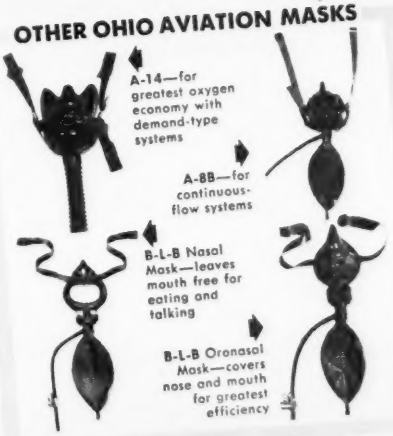
Introducing the
OHIO K-S *disposable*
OXYGEN MASK
FOR OXYGEN ALTITUDE X-C FLIGHTS

Now, OHIO offers a lightweight, inexpensive oxygen mask that can be discarded after use by one passenger. The new K-S Disposable Oronasal Oxygen Mask is

LIGHTWEIGHT
Clear, transparent plastic
SANITARY
Worn, then discarded
COMFORTABLE
Pliability insures pressure-free fit
EFFICIENT
Usable with any oxygen system

USE IT! DISCARD IT!
Packed for economy in boxes of 50

OTHER OHIO AVIATION MASKS


A-14—for greatest oxygen economy with demand-type systems
A-8B—for continuous-flow systems
B-L-B Nasal Mask—leaves mouth free for eating and talking
B-L-B Oronasal Mask—covers nose and mouth for greatest efficiency

FREE — Complete Manual for Aircraft Oxygen Engineering

Contains plans and description of all types of systems and equipment — the first complete manual of its kind. Write for your free copy.

OHIO CHEMICAL & SURGICAL EQUIPMENT CO.
A Division of Air Reduction Company, Incorporated
Aviation Equipment Dept. • CLEVELAND 14, OHIO

DIRK WESSELS VAN LEYDEN
General Manager • AA Argentine

C. R. SMITH, President
AMERICAN U.S.

CAPT. A. A. BARLOW, General Manager
BCPA Australian, New Zealand

T. E. BRANIFF, President
BRANIFF U.S.

IC. AARON SA
CMA M

The airlines these men direct are a vital part of

THE WORLD'S GREATEST AI

T. C. DRINKWATER, President
WESTERN U.S.

Today the 19 men pictured here operate airlines that comprise the world's largest airlift—serving free people everywhere.

Depend on **DOUGLAS**

WORLD'S LARGEST BUILDER OF MILITARY AND COMMERCIAL
AIRCRAFT FOR 30 YEARS ➤ MILITARY AND COMMERCIAL TRANSPORTS ➤ FIGHTERS
ATTACK PLANES ➤ BOMBERS ➤ GUIDED MISSILES ➤ ELECTRONIC EQUIPMENT ➤ RESEARCH

W. A. PATTERSON, President
UNITED U.S.

COL. P. GENAIN, Director General
TAI French

DR. W. BERCHTOLD, President
SWISSAIR Swiss

THOMAS L. GRACE, President
SLICK U.S.

The gia
flying
chosen
the DC
transp
Dougl
comm
are vi
Dougl

PER
SAS Da

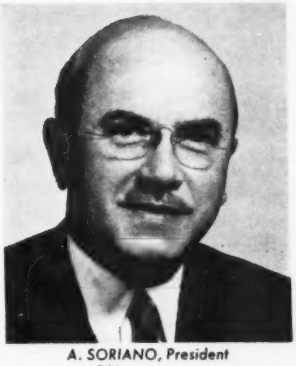
JC. AARON SAENZ, President
CMA Mexican

C. E. WOOLMAN, President and
General Manager • DELTA U. S.

DR. A. PLESMAN, President
KLM Netherlands

PRINCE M. PACELLI, President
LAI Italian

G. T. BAKER, President
NATIONAL U. S.



A. SORIANO, President
PAL Philippines

ANDREW B. SHEA, President
PANAGRA U. S.

JUAN T. TRIPPE, President
PAN AMERICAN U. S.

G. CLAEYS, Managing Director
SABENA Belgian

PER A. NORLIN, President
SAS Danish Norwegian Swedish

AIRLIFT!

The giant Douglas DC-6—finest of all modern transports—is now flying or on order for these airlines. No other post-war transport has been chosen by so many carriers. Proved over billions of flight miles, the DC-6 is the most economical to operate of all four-engine transports—even approaching the operating costs of twin-engine aircraft. Douglas believes that the continuing development of outstanding commercial air transports like the DC-6 and the growth of civil aviation are vital to the progress and security of the free nations of the world.

Douglas Aircraft Company, Inc.

FOR MILITARY X-RAY UNITS IN CONTAINERS OF

Rigidized

design strengthened textured Metals

Picker X-ray Chests, used by the Army Medical Corps, are made of RIGIDIZED METAL Pattern ACC-4i, .024" thick.

Here they come! X-ray units twisting down through the sky to help U. S. troops. And there's no worry about damage because they're thoroughly protected by containers made of rugged RIGIDIZED METALS. These Picker X-ray Containers reduce air weight because of the lightweight quality of RIGIDIZED METALS, and yet they're strong enough to take "bottom-of-the-load" positioning during transport, the impact of parachute landings, and general rough handling in the field. This exclusively-manufactured metal is three-dimensional and design-strengthened to CONSERVE STRATEGIC MATERIALS. High strength RIGIDIZED METAL is vitally important in this era of intensified *air transportation of war gear.* Get the facts *today.*

Write

on your company letterhead for a copy of the RIGIDIZED METALS CONSERVATION HANDBOOK today

U. S. and Foreign Patents

Rigidized Metals Corporation

67612 OHIO STREET BUFFALO 3, N. Y.

Offices in Principal Cities in the U. S. and Canada

Cable Address: "RIGIDIZED"

Lambert, Blake W., B. of Ae.E., Lt. Colonel, U.S.A.F.; Graduate Student, University of Florida.

Law, James G., B.S. in Ae.E., General Aero. Engineer, GS-7, Air Development Center, Wright-Patterson Air Force Base.

Lewis, Gladstone S., Jr., B.S., Lt., U.S.A.F.; Student Officer, Pilot Training, 3305th Training Sq., ATRC, Municipal Airport (Malden).

Lind, George F., B.S. in Ae.E., 2nd Lt., U.S.A.F.; Project Engineer, Air Development Center, Wright-Patterson Air Force Base.

Linhart, Emil J., B. of Ae.E., Experimental Test Engineer, Wright Aero. Corp., Div. of Curtiss-Wright Corp.

Livi, George D., B.S. in Ae.E., Stress Analyst, Goodyear Aircraft Corp.

Logan, Roy R., B.S. in Ae.E., Jr. Engineer "B," Draftsman, Boeing Airplane Co. (Seattle).

Lustig, Sanford, B. of Ae.E., Aero. Engineer, Stress Analyst, Air Development Center, Wright-Patterson Air Force Base.

Mackey, Wilfred G., B.S., 2nd Lt., U.S.A.F.R.

Majarucon, Felicito I., B.S. in Ae.E., Aero. Engineer, Aero. Design Div., N.A.M.T.C. (Pt. Mugu).

Markey, Melvin F., B.S., Research Engineer, N.A.C.A., Langley Air Force Base.

Masser, Paul, S.B., Aerophysics Engineer, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Miller, James A., B.Ae.E., Jr. Aerodynamics Engineer, Consolidated Vultee Aircraft Corp. (San Diego).

Miller, Myron J., B.S. in Ae.E. & Business Management, Jr. Engineer, Boeing Airplane Co.

Morrow, James E., B.A.E., Engineering Draftsman, North American Aviation, Inc. (Columbus).

Mothersole, George F., B.S., Jr. Engineer, Aerodynamics Group, Consolidated Vultee Aircraft Corp. (San Diego).

Moy, Tsoy K., B.S., Jr. Engineer "B," Boeing Airplane Co. (Seattle).

Munro, David D., III, M.S.E. (Aero.), Captain, U.S.A.F.; Project Officer, Bombardment Branch, Aircraft Section, Weapons System Div., Air Development Center, Wright-Patterson Air Force Base.

Mussett, Earl W., Weight Analyst "A," Douglas Aircraft Co., Inc. (Santa Monica).

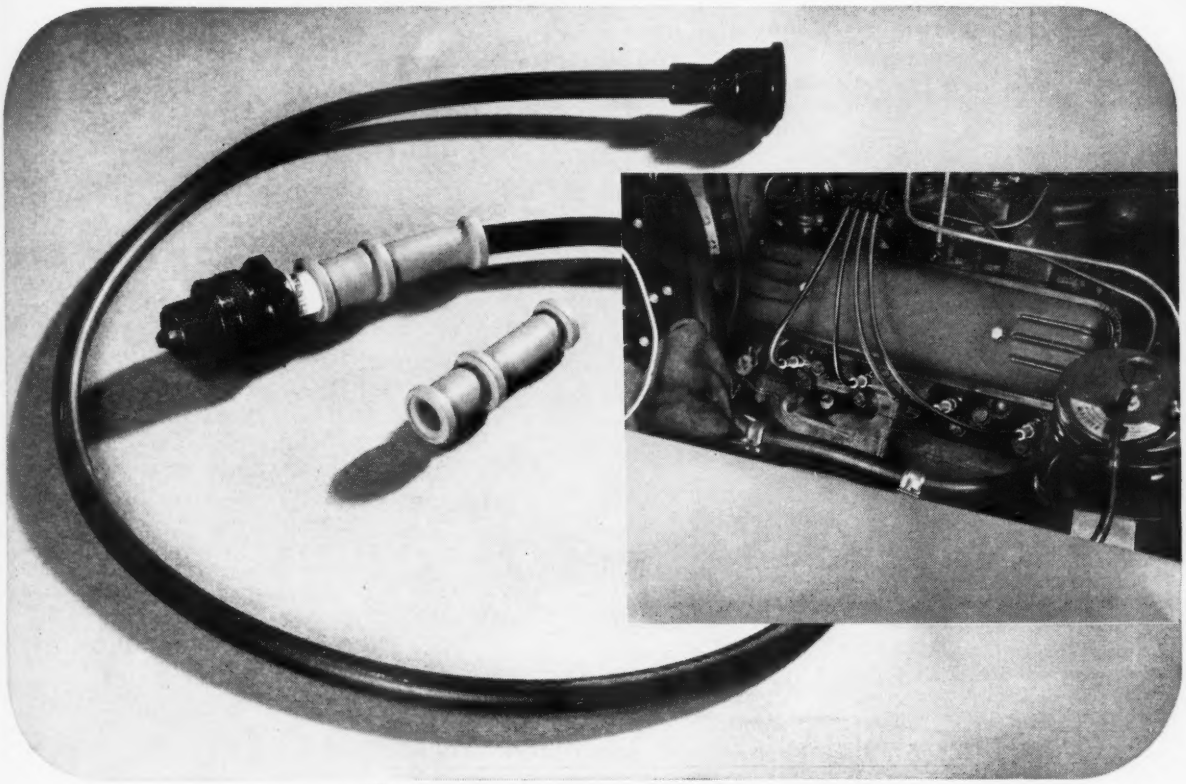
Nielsen, Helmer L., B.S., Aero. Research Scientist—Aerodynamics, Ames Aero. Lab., N.A.C.A.

Olinger, Max E., B.S., Aero. Engineer, Globe Corp.; Assigned to Flight Test Div. (Pt. Mugu).

Pannell, William H., Jr., Engineering Design Draftsman, Preliminary Design Group, Harper Engineering Co.

Poch, Leonard J., B.Ae.E., Jr. Engineer, Propeller Performance Calculations, Curtiss-Wright Corp. (Caldwell).

Post, John R., B.Ae.E., 2nd Lt., U.S.A.F.; currently assigned to Officers' Communications School, Scott Air Force Base (Illinois).



SILASTIC* boots plug ignition leaks!

It's no longer a trade-secret that some of the leading automobile manufacturers are using Silastic boots to plug ignition leaks. Molded of Silastic 250, these spark plug boots exclude moisture; remain flexible for an indefinitely long period of time at sub-zero temperatures and at operating temperatures in the range of 400° - 450°F. They withstand hot oil and they keep a spark at 27,000 to 40,000 volts from jumping over the outside of the plug.

These are the properties of Silastic that make engines easy to start even on a wet morning. And these are the properties that start engineers to work simplifying the design and increasing the service life of hot air shut-off valves, transmission systems, cooling fins on aircraft engines, anti-icing systems, traction motors, transformers and cable. You can do extraordinary things with Silastic, the Dow Corning silicone rubber that retains its properties over a temperature span of more than 600 degrees from —100° to +500°F.

*T.M.REG.U.S.PAT.OFF.

Please return this coupon

to DOW CORNING CORPORATION, MIDLAND, MICHIGAN

Please send me
- ☐ Silastic Facts No. 10 on properties and applications. A-12A
- ☐ Silastic Fabricators for sources of supply. A-12B

Name_____

Title or Dept._____

Company_____

Address_____

City_____ Zone_____ State_____

FIRST IN SILICONES

DOW CORNING CORPORATION

MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • LOS ANGELES • NEW YORK • WASHINGTON, D. C.

In CANADA: Fiberglas Canada, Ltd., Toronto • In GREAT BRITAIN: Midland Silicones, Ltd., London

Potter, Kenneth H., B.A.E., Lt., U.S.A.F.; Student Officer, 3401st Student Squadron, Keesler Air Force Base.

Price, Milo V., B.S., Service Engineer, Customer Service Dept., Douglas Aircraft Co., Inc. (El Segundo).

Putman, James L., B.S., Aerodynamicist, Northrop Aircraft, Inc.

Reilly, Dwight H., Jr., B. of Ae.E., Aero. Propulsion Research Intern, N.A.C.A. (Cleveland).

Reschke, William G., Jr., B.S. in Ae.E., Lt., U.S.A.F.; Maintenance Officer, 3307th Training Sq., 29th Air Div. (Arizona).

Romine, J. D., Jr., B. of Ae.E., Jr. Engineer, Structural Design Group, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Sanlorenzo, Ernest A., S.B., Engineering Trainee, ARO, Inc.

Sarles, Peter M., B.A.E., Jr. Engineer, Aviation Gas Turbine Div., Westinghouse Electric Corp.

Schultz, Kenneth W., B. of A.E., Lt. Colonel & Pilot, U.S.A.F.; Asst. Chief, Design Branch, Air Development Center, Wright-Patterson Air Force Base.

Setescak, George J., Weights Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Shaver, Clifford J., B. of A.E., 2nd Lt., U.S.A.F.

Snedeker, Richard S., B.S. in Engineering, Draftsman for High Speed Aerodynamics Publication Project, Princeton University Press.

Southern, Edgar R., Draftsman, Robert B. Taylor, Engineering.

Spicer, Herbert C., Jr., B.S., Engineering Technician, Basic Loads Group, Structures Dept., Lockheed Aircraft Corp. (Burbank).

Staubach, Richard L., B.S., Engineer, Design Analysis Group, Meteor Section, United Aircraft Corp. (East Hartford).

Steffen, Fred W., B.Ae.E., Aero. Research Intern, Engineering Aide, Lewis Flight Propulsion Lab., N.A.C.A.

Sullivan, William J., Jr., S.B., Jr. Design Engineer, Boeing Airplane Co. (Seattle).

Taigman, Leonard G., S.B., 2nd Lt., U.S.A.F.; Research & Development Officer, Air Development Center, Wright-Patterson Air Force Base.

Tomich, Michael J., B. of Ae.E., Tech. Engineer, Aviation Gas Turbine Div., General Electric Co. (Lockland).

Trett, Donald W., B.S.M.E. (Aero.), Flight Test Analyst, Boeing Airplane Co. (Wichita).

Tripp, Lee A., Engineering Design Draftsman, Airplane Structures, Harper Engineering Co.

Twomey, Edward J., B.Ae.E.

Wallskog, Harvey A., B.S., Aero. Aerodynamics Research Intern, Aircraft Component Section, Langley Aero. Lab., N.A.C.A.

Wesolowski, Joseph P., B. of Ae.E., Jr. Test Engineer, Combustion Research, Wright Aero. Corp., Div. of Curtiss-Wright Corp.

Wiesinger, Carl J., B.S., Flight Test Analyst, Douglas Aircraft Co., Inc. (Santa Monica).

Wilbur, Claude M., Jr., B.E., Aerodynamicist, Northrop Aircraft, Inc.

Woodruff, Paul I., B.A.Sc. (A.E.), Engineer "C," Flight Test Group, Aerodynamics Section, Canadair, Ltd.

Yancey, I. Victor, B.S. in Ae.E., Aero. Engineer, Air Development Center, Wright-Patterson Air Force Base.

Yip, Clifford, Draftsman "B," Northrop Aircraft, Inc.

Some Observations on Aeronautical Research in England with Particular Reference to Stability and Control

(Continued from page 46)

in the United Kingdom is not immediately pressing, while, in research circles, the American data are available for comparison with wind-tunnel or theoretical results.

The lack of English activity in the rationalization of handling qualities specifications by artificial stability is not easily explained. The persons with whom the writer talked were by no means convinced that "optimum" flying qualities characteristics for the manually flown aircraft could be determined and promulgated. Thus, there was the feeling that the human pilot and his behavior were much too variable to warrant substantial research for the modification of the present specifications. There was also a mildly negative reaction to the possibility of quantitatively measuring the dynamics of a human being and, in turn, applying these in a loop analysis of flying characteristics. The British were also skeptical that the phugoid and spiral modes were of research concern at the present time, though there is a sizable body of evidence from American and Canadian experience which already indicates operational difficulties.

Relative to research on atmospheric gusts there is much enthusiasm on the part of the British. More specific use of "noise" theory should follow upon familiarity with the techniques, while, at the present time, their efforts lie in related directions. The general consensus was that both a more detailed knowledge of individual gust shapes plus the statistical data are necessary. The distinction between the type of gust research suitable for structural analysis and that apropos of flight characteristics is more universally recognized in British research circles than in this country. Also, the desirability of determining the frequency response of aircraft to gust inputs seemed obvious and desirable to those with whom the matter was discussed. One Australian scheme was proposed for flying an airplane into the up-gust produced by a natural wind blowing over an obstruction while simultaneously surveying the air structure in the immediate vicinity. Needless to state, any discussion of gust research ultimately leads to "clear air" gustiness and standing wave phenomena. Here the British work predominated, though they are the first to point out the desirability of continued exploration and measurement.

In conclusion, it can only be said that the advantages of the closest possible liaison with British aeronautical research, on a personal basis, are many. The differences existing in points of view, philosophy, and methods of attack should but serve to temper our mutual efforts.

The increasing use of Aeroprops on Air Force and Navy aircraft has resulted in an accelerated service program. Technical representatives who are qualified service engineers are available and being assigned to military bases at widespread locations.

In addition, the Aeroproducts service program is training military specialists qualified to install, maintain, and operate Aeroprops. Service literature, technical bulletins and parts catalogs keep in step with design and production changes.

This is an expanding program—expanding rapidly to fill the needs of the armed forces. It is a program designed to meet the service needs of the military forces.

Building for today
Designing for tomorrow

AEROPRODUCTS
GM

GM
GENERAL MOTORS

AEROPRODUCTS DIVISION
GENERAL MOTORS CORPORATION
DAYTON, OHIO

Aeroproducts

B.F.Goodrich

New De-Icer for fast night attacker proved in Korea

DOUGLAS SKYRAIDERS attacking with the fleet in Korea were forced to fly low at night because of the danger of ice forming at higher altitudes. They needed De-Icers—and fast.

De-Icers had never before been used on this type of high-speed plane. The Navy and Douglas brought the problem to B. F. Goodrich.

There were two big questions. Would De-Icers stay on at these high speeds? Would they upset the flight characteristics of the plane?

Within 32 days, BFG engineers in co-operation with Douglas designed, installed, and test-flew a new type of De-Icer on a Skyraider. The entire inner surface—not just the edges—of the new De-Icer was cemented to the wing. A screwed-on fairing strip was added for further reinforcement. Tested in a high-speed dive, the new De-Icers came through without a sign of damage. They had no appreciable effect on flight characteristics.

Quickly put into production, the De-Icers were soon seeing service over Korea, where they have done an excellent job.

These new BFG De-Icers operate safely at 15 to 18 lbs. pressure. They are light in weight, yet tough and long lasting. Take up little space for their plumbing. Are easily maintained. They are now proved practical for high-speed single engine planes as well as twin engine or larger.

The De-Icer, safest ice-removal device for airplane leading edges yet developed, is another product of B. F. Goodrich aeronautical research and engineering. Let us help you design De-Icers into your single engine planes. Write: *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

B.F.Goodrich

FIRST IN RUBBER

Aeronautical Reviews

A Guide to the Current Literature of Aeronautical Research and Engineering

I. PERIODICALS AND REPORTS

The abstracts are classified according to the Air Technical Index Distribution Guide. Numbers in parentheses indicate the position of the Division Headings in the numerical arrangement.

Aerodynamics (2)
- Boundary Layer . . . 86
- Control Surfaces . . . 86
- Fluid Mechanics & Aerodynamic Theory . . . 87
- Internal Flow . . . 87
- Parasitic Components & Interference . . . 88
- Performance . . . 88
- Stability & Control . . . 88
- Thermoaerodynamics . . . 88
- Wings & Airfoils . . . 88

Aeroelasticity . . . 90
Air Transportation (41) . . . 90
Airplane Design (10) . . . 92
- Airplane Descriptions . . . 92
- Control Systems . . . 92
- Landing Gear . . . 92
- Windshields . . . 92
- Wing Group . . . 92

Airports (39) . . . 94
Aviation Medicine (19) . . . 94
Electronics (3)
- Antennas . . . 94
- Circuits & Circuit Elements . . . 94
- Communications . . . 94
- Components . . . 96
- Construction Techniques . . . 96
- Electronic Controls . . . 96
- Electronic Tubes . . . 96
- Measurements & Testing . . . 96
- Navigation Aids . . . 96
- Noise & Interference . . . 96
- Radar . . . 96
- Transmission Lines . . . 96
- Wave Propagation . . . 96

Equipment
- Electric (16) . . . 99
- Hydraulic (20) . . . 99

Flight Safety & Rescue (15) . . . 99
Flight Testing (13) . . . 100
Fuels & Lubricants (12) . . . 100
Guided Missiles (1) . . . 100
Instruments (9) . . . 100
Lighter-Than-Air (40) . . . 100
Machine Elements (14) . . . 100
- Gears & Cams . . . 100
- Shafts & Rotating Discs . . . 100

Maintenance (25) . . . 102
Materials (8) . . . 102
- Ceramics & Ceramals . . . 102
- Metals & Alloys . . . 102
- Nonmetallic Materials . . . 102
- Protective Coatings . . . 104
- Sandwich Materials . . . 104

Meteorology (30) . . . 104
Navigation (29) . . . 104
Ordnance & Armament (22) . . . 106
Parachutes . . . 106
Photography (26) . . . 106
Power Plants . . . 106
- Jet & Turbine (5) . . . 106
- Reciprocating (6) . . . 106
- Rocket (4) . . . 106

Production (36) . . . 106
Propellers (11) . . . 108
Reference Works (47)
- Bibliographies . . . 108
- Dictionaries . . . 108

Rotating Wing Aircraft (34) . . . 109
Sciences, General (33)
- Mathematics . . . 109
- Physics . . . 111

Space Travel . . . 111
Structures (7) . . . 111
Thermodynamics (18) . . . 111
Water-Borne Aircraft (21) . . . 113
Wind Tunnels & Research Facilities . . . 113

II. BOOKS REVIEWED IN THIS ISSUE

Grenzschicht-Theorie. Hermann Schlichting . . . **115**
Reviewed by Albert E. von Doenhoff, N.A.C.A.

Thermodynamics of Fluid Flow. Newman A. Hall . . . **115**
Reviewed by Howard W. Emmons, Harvard University

Problems of Cosmical Aerodynamics . . . **116**
Reviewed by August Raspet, Mississippi State College

Advances in Applied Mechanics, Vol. II. R. von Mises and Theodore von Kármán, Editors . . . **119**
Reviewed by Stephen J. Zand, Lord Manufacturing Company

The Aircraft Industry. W. G. Cunningham . . . **120**
Reviewed by George S. Armstrong, Consulting Engineer

Book Notes . . . **122**

Books, reports, and periodicals reviewed in this issue or in previous issues may be borrowed on 2-week loan without charge by individual or Corporate Members of the Institute in the U.S. and Canada. Members of The Paul Kollsman Lending Library who are not Members of the Institute may borrow books and, in special cases, other research material. Members of the I.A.S. may borrow also from the Engineering Societies Library through The Paul Kollsman Lending Library.

Photostatic copies of material in the Institute's libraries may be obtained at a cost of $0.30 to members and Corporate Members ($0.40 to nonmembers) for each 8½- by 11-in. print and $0.35 to members and Corporate Members ($0.45 to nonmembers) for each 11½- by 14-in. print, plus postage. A service charge of $1.00 is made to nonmembers of the I.A.S. Rates for *microfilm copies* will be sent on request.

Bibliographies on special subjects will be compiled at the rate of $2.50 per hour. *Translations* of technical literature from foreign languages may be obtained at $12 to $14 per 1,000 words, depending on the language. I.A.S. members receive a 20 per cent discount on bibliographies and translations.

Full information about library membership and facilities will be sent upon request to The Paul Kollsman Lending Library, 2 East 64th St., New York 21, N.Y.

AVOID VERBAL ORDERS

TO: Advertising Dept.

The attached scratchboard drawing is good -- but you still don't show the detail and precision that we build into these gears.

John L. Buehler

INDIANA GEAR WORKS
INDIANAPOLIS 7, INDIANA
IGW

Aerodynamics (2)

BOUNDARY LAYER

Interrelationship Between Boundary Layer and Base Pressure. H. H. Kurzweg. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 743–749, illus. 5 references.

Base-pressure measurements on cone-cylinder bodies of 5-cm. diameter with and without boat-tails at $M = 1.5$–5.00 in the N.O.L. Aeroballistics Tunnel, and on 30-caliber projectiles at Mach Numbers up to 3.5 and a pressure range of 3 to 120 in. Hg in the N.O.L. Pressurized Ballistics Range; effects of the boundary-layer conditions of the body, including surface friction and heat transfer.

Skin Friction of Incompressible Turbulent Boundary Layers Under Adverse Pressure Gradients. Fabio R. Goldschmied. *U.S., N.A.C.A., Technical Note No. 2431*, August, 1951. 65 pp., illus. 27 references.

Comparative analysis of the total-heat, heat transfer, and hot-wire anemometer methods of measuring turbulent skin friction in an adverse pressure gradient; review of data obtained by previous investigators.

Approximate Method of Integration of Laminar Boundary Layer in Incompressible Fluid. L. G. Loitsianskii. (*Prikladnaia Matematika i Mekhanika*, Moscow, Vol. 13, No. 5, October, 1949, pp. 513–535.) *U.S., N.A.C.A., Technical Memorandum No. 1293*, July, 1951. 21 pp., illus. 10 references. Solution for the plane laminar boundary layer in an incompressible gas, based on the use of a fundamental system of successive moments of the boundary layer equation.

Boundary Layer in Convergent Flow Between Spiral Walls. G. Kuerti. *Journal of Mathematics and Physics*, Vol. 30, No. 2, July, 1951, pp. 106–115, illus. 10 references.

Analysis of a sink flow between spiral walls. The solution of the corresponding boundary-layer equation is obtained as the asymptotic form of Hamel's solution for convergent (sink) flow between radial walls. The solution holds for any width of channel and any degree of obliqueness of the spiral streamline, except for the case where the spiral degenerates into a circle.

CONTROL SURFACES

Effect of High-Lift Devices on the Low-Speed Static Lateral and Yawing Stability Characteristics of an Untapered 45° Sweptback Wing. Jacob H. Lichtenstein. *U.S., N.A.C.A., Research Memorandum No. L8G20*, September 30, 1948. 21 pp., illus. 3 references.

Theoretical Characteristics of Two-Dimensional Supersonic Control Surfaces. Robert R. Morrissette and Lester F. Oborny. *U.S., N.A.C.A., Research Memorandum No. L8G12*, July 27, 1948. 74 pp., illus. 5 references.

The Effectiveness of a Trailing-Edge Spoiler on a Swept-Back Airfoil at Transonic Speeds from Tests by the NACA Wing-Flow Method. Norman S. Silsby and Fred L. Daum. *U.S., N.A.C.A. Research Memorandum No. L6K12a*, January 20, 1947. 13 pp., illus. 3 references.

Lateral Control by Spoilers at the DVL. I—Systematic Wind-Tunnel Tests Concerning the Problem of Lateral Control by Spoilers Permeable to Air. M. Kramer and Th. Zobel. **II—Contribution to the Lateral Control by Spoilers at the DVL.** M. Kramer. **III—Flight Tests in the Lateral Controls by Spoilers on the Airplane Model Fieseler Fi 156.** C. G. Esche. (*ZWB, Forschungsbericht Nr. 964*, July 13, May 24, 1938, May 13, 1939.) *U.S., N.A.C.A., Technical Memorandum No. 1307*, August, 1951. 82 pp., illus. 20 references. Development of spoiler control in Germany from 1936 to 1939.

Aerodynamic Load Measurements over Leading-Edge and Trailing-Edge Plain Flaps on a 6-Percent Thick Symmetrical Circular-Arc Airfoil Section. William J. Underwood and Robert J. Nuber. *U.S., N.A.C.A., Research Memorandum No. L7H04*, October 22, 1947. 43 pp., illus. 3 references.

FH-1 Elevator Investigations. C. James. *Cornell Aeronautical Laboratory, Inc., Report No. FRM 122*, June 15, 1951. 37 pp., illus. Experimental investigation of the forces and moments acting on the elevator control system of a FH-1 aircraft.

Wind-Tunnel Investigation of the Contribution of a Vertical Tail to the Directional Stability of a Fighter-Type Airplane. Alfred A. Marino and N. Mastrocola. *U.S., N.A.C.A., Research Memorandum No. L7K03*, April 15, 1948. 42 pp., illus. 4 references.

An Analytical Investigation of Effect of High-Lift Flaps on Take-Off of Light Airplanes. Fred E. Weick, L. E. Flanagan, Jr., and H. H. Cherry. *U.S., N.A.C.A., Technical Note No. 2404*, September, 1951. 101 pp., illus. 58 references.

Determination of the optimum C_L for take-off of four-place personal-type aircraft; comparison of existing high-lift and control-device data applicable for aircraft of this type; computations to verify these theoretical conclusions.

FLUID MECHANICS & AERODYNAMIC THEORY

Some Measurements of the Effect of Gaseous Imperfections on the Critical Pressure Ratio in Air and the Speed of Sound in Nitrogen. Coleman duP. Donaldson and Jim J. Jones. *U.S., N.A.C.A., Technical Note No. 2437*, August, 1951. 15 pp., illus. 2 references.

Measurement of the speed of sound in nitrogen at 545°F. absolute over a pressure range of 0 to 2,000 lbs. per sq.in. absolute, and of the critical pressure ratio in air at 500°F. absolute over a pressure range of 0 to 1,800 lbs. per sq.in. absolute; comparison with values predicted by the Van der Waals and Beattie-Bridgeman equations.

Heat Delivery in a Compressible Flow and Applications to Hot-Wire Anemometry. Chan-Mou Tchen. *U.S., N.A.C.A., Technical Note No. 2436*, August, 1951. 63 pp., illus. 6 references.

Development of the generalized potential theory for a flow with rotation and variable heat energy; analysis of the distributions of heat energy and heat flux, the amount of heat delivery, and the perturbations of the flow by heat. A straight array of continuous heat sources, parallel to a stream of uniform velocity, was used for this study. Heat delivery at subsonic and supersonic speeds was calculated, including the effects of compressibility and nonlinear cooling in the results.

Effect of Compressibility on the Flow Past a Two-Dimensional Bump. W. F. Lindsey and Bernard N. Daley. *U.S., N.A.C.A., Research Memorandum No. L6K12b*, January 22, 1947. 37 pp., illus. 13 references.

Readers' Forum: Local Compressible Pressure Coefficient. V. G. Szebehely. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 772, 773. 6 references. Evaluation of the use of the local Mach Number for computing compressible pressure coefficients.

Transformations of the Hodograph Flow Equation and the Introduction of Two Generalized Potential Functions. Luigi Crocco. *U.S., N.A.C.A., Technical Note No. 2432*, August, 1951. 81 pp., illus. 15 references.

Derivation of the hodograph equations in a symmetric form, using the velocity and mass velocity (and not the connection between them) as independent variables. A generalized potential function is introduced, from which the complex functions can be obtained as simple differentiations.

The Flow of Gases in Narrow Channels. R. E. H. Rasmussen. (*Annalen der Physik*, Vol. 29, No. 8, August, 1937, pp. 665–697.) *U.S., N.A.C.A., Technical Memorandum No. 1301*, August, 1951. 46 pp., illus. 15 references. Measurements of the flow of H_2, O_2, CO_2, A, and air per sec. per unit of pressure difference through four types of narrow channels at pressures of from 0.00003 to 45 cm. Hg.

The Similarity Law for Hypersonic Flow About Slender Three-Dimensional Shapes. Frank M. Hamaker, Stanford E. Neice, and A. J. Eggers, Jr. *U.S., N.A.C.A., Technical Note No. 2443*, August, 1951. 22 pp., illus. 7 references.

Development of a general form of the law, in terms of conventional aerodynamic parameters, for the steady, inviscid hypersonic flow about slender three-dimensional bodies of arbitrary shapes. The shapes studied were wings, bodies, and wing-body combinations.

A Comparison of the Experimental Subsonic Pressure Distributions About Several Bodies of Revolution with Pressure Distributions Computed by Means of the Linearized Theory. Clarence W. Matthews. *U.S., N.A.C.A., Research Memorandum No. L9F28*, September 12, 1949. 52 pp., illus. 10 references.

Readers' Forum: Proper Use of the M.I.T. Tables for Supersonic Flow Past Inclined Cones. Antonio Ferri. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, p. 771. 1 reference.

Readers' Forum: A Simple Rule for the Velocity Rise with Subsonic Mach Number on Ellipsoids of Revolution. D. Küchemann. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, p. 770, illus. 4 references.

Readers' Forum: Concerning Hadamard's Solution for a Source in Supersonic Flow. E. V. Laitone. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, p. 775. 2 references.

Flow of Gases in Porous Media. L. H. Wilson, W. L. Sibbitt, and M. Jakob. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1027–1030, illus. 7 references.

Theoretical review of viscous and free molecular flow phenomena. A stainless-steel test chamber was constructed to determine the critical values of the ratio of molecular mean free path to pore diameter (of the porous medium), and to study generally flow in a porous medium.

Heat Transfer to Bodies in a High-Speed Rarefied-Gas Stream. Jackson R. Stalder, Glen Goodwin, and Marcus O. Creager. *U.S., N.A.C.A., Technical Note No. 2438*, August, 1951. 25 pp., illus. 23 references.

Measurement of the equilibrium temperatures and heat-transfer coefficients for cylinders of 0.0010-, 0.0050-, 0.030-, 0.051-, 0.080-, and 0.126-in. diameter held normal to a high-speed stream of rarefied gas. Free-stream Reynolds Number range was 0.28 to 203; Knudsen Number (ratio of molecular-mean-free path to cylinder diameter), from 0.025 to 11.8; and Mach Number, from 2.0 to 3.3.

Readers' Forum: Strength of Reflected Shock in Mach Reflection. H. S. Tan. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 768, 769, 770, illus. 4 references. Analysis of reflected shock strength, using Lighthill's first-order pressure solution.

On the Recording of Turbulent Longitudinal and Transverse Fluctuations. H. Reichardt. (*Zeitschrift für angewandte Mathematik und Mechanik*, Vol. 18, No. 6, December, 1938, pp. 358–361.) *U.S., N.A.C.A., Technical Memorandum No. 1313*, August, 1951. 10 pp., illus. 2 references. Directional-probe design and principles of operation for studying nonisotropic turbulence.

Readers' Forum: An Integral Relation from the Turbulent Energy Equation. Stanley Corrsin. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 773, 774, illus. 7 references. Development of an integral relation for the mean motion from the boundary-layer form of the turbulent energy equation.

INTERNAL FLOW

Generalization of Joukowski Formula to an Airfoil of a Cascade in Compressible Gas Stream with Subsonic Velocities. L. G. Loitsianskii. (*Prikladnaia Matematika i Mekhanika*, Moscow, Vol. 13, No. 2, 1949, pp. 209–216.) *U.S., N.A.C.A., Technical Memorandum No. 1304*, September, 1951. 16 pp., illus. 2 references. Application to a cascade in compressible flow, assuming that the density is the arithmetic mean of the densities at infinity ahead of and behind the cascade.

Resistance of Cascade of Airfoils in Gas Stream at Subsonic Velocity. L. G. Loitsianskii. (*Prikladnaia Matematika i Mekhanika*, Moscow, Vol. 13, No. 2, 1949.) *U.S., N.A.C.A., Technical Memorandum No. 1303*, September, 1951. 30 pp., illus. 5 references. Computation procedure. The resistance is obtained in terms of the boundary-layer properties at the trailing edge of the airfoil in the cascade.

Further Comparisons of Theoretical and Experimental Lift and Pressure Distributions on Airfoils in Cascade at Low-Subsonic Speed. S. Katzoff and Margery E. Hannah. *U.S., N.A.C.A., Technical Note No. 2391*, August, 1951. 24 pp., illus. 9 references. Studies on five compressor-type cascades of highly cambered N.A.C.A. 6-series airfoils.

A Method of Designing Turbomachine Blades with a Desirable Thickness Distribution for Compressible Flow Along an Arbitrary Stream Filament of Revolution. Chung-Hua Wu and Curtis A. Brown. *U.S., N.A.C.A., Technical Note No. 2455*, September, 1951. 45 pp., illus. 18 references.

Performance of a Mixed-Flow Impeller in Combination with a Semivaneless Diffuser. Eugene B. Laskin and Milton G. Kofskey. *U.S., N.A.C.A., Research Memorandum No. E7C05a*, April 4, 1947. 17 pp., illus. 3 references.

The Theory of Waves Travelling on the Core in a Swirling Liquid. A. M. Binnie. *Royal Society (London), Proceedings, Series A, Mathematical and Physical Sciences*, Vol. 205, No. 1083, March 7, 1951, pp. 530–540, illus. 11 references.

Analysis of waves moving under centrifugal force and surface tension along the core in a swirling liquid. The liquid is assumed

to be inviscid, and both helical waves and waves of a form, in which the core cross section remains circular, occur. The problem is studied by means of the theory of oscillations of a core formed in a straight tube of uniform diameter.

Theoretical Investigation of Submerged Inlets at Low Speeds. Alvin H. Sacks and John R. Spreiter. *U.S., N.A.C.A., Technical Note No. 2323*, August, 1951. 48 pp., illus. 13 references.

Theoretical, wind-tunnel, and visual-flow studies of the flow in submerged air inlets with parallel, divergent, and convergent ramp walls to determine the effects of design parameters on the ram-recovery characteristics at low speeds.

On the Stability of Two-Dimensional Laminar Jet Flow of Gas. S. I. Pai. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 731–743, illus. 20 references.

Investigation of the stability of two-dimensional laminar jet flow of an incompressible and a compressible fluid, for both symmetric and asymmetric disturbances. The analysis is based on the methods of Heisenberg, Lin, and Lees. The study of the compressible fluid includes the effects of compressibility and heat transfer.

Correspondence on "Critical Flow Through Convergent Nozzles," by V. D. Naylor. D. B. Spalding and J. M. Stephenson. **Author's Reply.** *Aircraft Engineering*, Vol. 23, No. 270, August, 1951, pp. 238, 245. 6 references.

PARASITIC COMPONENTS & INTERFERENCE

Interrelationship Between Boundary Layer and Base Pressure. H. H. Kurzweg. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 743–748, illus. 5 references.

Base-pressure measurements on cone-cylinder bodies of 5-cm. diameter with and without boat-tails at $M = 1.5$–5.00. in the N.O.L. Aeroballistics Tunnel and on 30-caliber projectiles at Mach Numbers up to 3.5 and a pressure range of 3 to 120 in. Hg in the N.O.L. Pressurized Ballistics Range; effects of the boundary-layer conditions of the body, including surface friction and heat transfer.

Effect of Ground Interference on the Aerodynamic Characteristics of a 42° Sweptback Wing. G. Chester Furlong and Thomas V. Bollech. *U.S., N.A.C.A., Research Memorandum No. L8FO4*, September 7, 1948. 27 pp., illus. 6 references.

The Separation of Viscous Drag and Wave Drag by Means of the Wake Survey. Marshall P. Tulin. *U.S., Navy Department, David W. Taylor Model Basin, Report No. 772*, July, 1951. 6 pp., illus. 7 references.

Development of a method based on Betz's technique of wake surveys for studying submerged flows but modified to account for the difference between submerged and surface flows.

PERFORMANCE

The Effect of Rate of Change of Angle of Attack on the Maximum Lift Coefficient of a Pursuit Airplane. Burnett L. Gadeberg. *U.S., N.A.C.A., Research Memorandum No. A8I30*, January 20, 1949. 19 pp., illus. 3 references.

Effect of Mach Number on the Maximum Lift and Buffeting Boundary Determined in Flight on a North American P-51D Airplane. John P. Mayer. *U.S., N.A.C.A., Research Memorandum No. L6I10*, June 12, 1947. 19 pp., illus. 6 references.

Effect of Fuselage and Tail Surfaces on Low-Speed Yawing Characteristics of a Swept-Wing Model As Determined in Curved-Flow Test Section of Langley Stability Tunnel. John D. Bird, Byron M. Jaquet, and John W. Cowan. *U.S., N.A.C.A., Research Memorandum No. L8G13*, August 31, 1948. 20 pp., illus. 3 references.

Saving of Power in Formation Flying. H. Schlichting. (*Brunswick, Technische Hochschule, Aerodynamisches Institut, Bericht No. 42/6*, June 15, 1942.) *U.S., Navy Department, David W. Taylor Model Basin, Translation No. 239*, October, 1950. 38 pp., illus. 3 references.

Analysis of the mutual influence of the individual aircraft of a formation, using the Prandtl airfoil theory. An upwash is generated around the aircraft, which, in the formation, results in a reduction in drag and a power saving. The optimum formation is a V with the vertex at the front.

Formation Flying in Stepped-Up Formation. H. Schlichting. (*Brunswick, Technische Hochschule, Aerodynamisches Institut, Bericht No. 44/7*, February 15, 1944.) *U.S., Navy Department, David W. Taylor Model Basin, Translation No. 240*, October, 1950. 22 pp., illus. 1 reference. Calculations of the saving in power in formation flying for a formation with arbitrary vertical stagger of the aircraft.

STABILITY & CONTROL

Investigation of the Influence of Fuselage and Tail Surfaces on Low-Speed Static Stability and Rolling Characteristics of a Swept-Wing Model. John D. Bird, Jacob H. Lichtenstein, and Byron M. Jaquet. *U.S., N.A.C.A., Research Memorandum No L7H15*, October 15, 1947. 19 pp., illus. 6 references.

Stability and Control Characteristics of an Airplane Model Having a 45.1° Swept-Back Wing with Aspect Ratio 2.50 and Taper Ratio 0.42 and a 42.8° Swept-Back Horizontal Tail with Aspect Ratio 3.87 and Taper Ratio 0.49. Marvin Schuldenfrei, Paul Comisarow, and Kenneth W. Goodson. *U.S., N.A.C.A., Research Memorandum No. L7B25*, May 8, 1947. 91 pp., illus. 6 references.

Summary of Methods for Calculating Dynamic Lateral Stability and Response and for Estimating Lateral Stability Derivatives. John P. Campbell and Marion O. McKinney. *U.S., N.A.C.A., Technical Note No. 2409*, July, 1951. 97 pp., illus. 120 references.

Methods for calculating the time histories of lateral motions, their period and damping. The lateral stability boundaries are summarized and presented in a manner suitable for rapid calculations.

Longitudinal Stability and Control of High-Speed Airplanes with Particular Reference to Dive Recovery. John A. Axelson. *U.S., N.A.C.A., Research Memorandum No. A7C24*, September 4, 1947. 25 pp., illus. 7 references.

THERMOAERODYNAMICS

Effect of Turbulence Level of Incident Air Stream on Local Heat Transfer Skin Friction on a Cylinder. W. H. Giedt. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 725–730, 766, illus. 9 references.

Presentation and analysis of data for the local heat-transfer coefficient, pressure coefficient, and skin-friction coefficient on a cylinder over a Reynolds Number range of 7.08×10^4 to 2.19×10^5, with and without turbulence in the air stream.

Aero Digest Scientific Review: Guided Missile Friction Heating. Robert McLarren. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 27–29, 80, 82, 84, 86, illus. 19 references.

The Effect of Flight and Configuration Variables on Thermal Stresses in Diamond-Shaped Supersonic Wings. Franklin P. Durham. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 755–766, illus. 16 references.

Analytic and experimental investigation of the temperature distributions and thermal stresses on a solid, thin, diamond-shaped wing subject to an instantaneous acceleration to a supersonic Mach Number at altitudes up to 100,000 ft. Tests were carried out to determine the effects of flight conditions and configuration considerations on the thermal stresses.

WINGS & AIRFOILS

Wind-Tunnel Investigation and Analysis of the Effects of End Plates on the Aerodynamic Characteristics of an Unswept Wing. Donald R. Riley. *U.S., N.A.C.A., Technical Note No. 2440*, August, 1951. 55 pp., illus. 13 references.

Studies of an unswept, untapered wing of aspect ratio 4 in the Langley stability tunnel to determine the effects of end plates of various shapes and sizes; comparison with theory; theoretical analysis of the effects of the factors that influence L/D and $(L/D)_{max}$.

Effects of Aspect Ratio on Air Flow at High Subsonic Mach Numbers. W. F. Lindsey and Milton D. Humphreys. *U.S., N.A.C.A., Research Memorandum No. L8G23*, October 4, 1948. 13 pp., illus. 3 references.

The Direct and the Inverse Problem of Aerofoil Theory; A Method to Obtain Numerical Solutions. R. Timman. *Netherlands, Nationaal Luchtvaartlaboratorium, Amsterdam, Report No. F.16* (*Reports and Transactions*, Vol. 16, pp. F1–F30), 1951. 30 pp., illus., folding chart. 24 references. Review of work on the theory of incompressible two-dimensional potential flow about airfoils; formulation of a basic theory.

Readers' Forum: On Slender Wing Theory. John W. Miles. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 770, 771. 6 references. Alternate (to Stewartson's

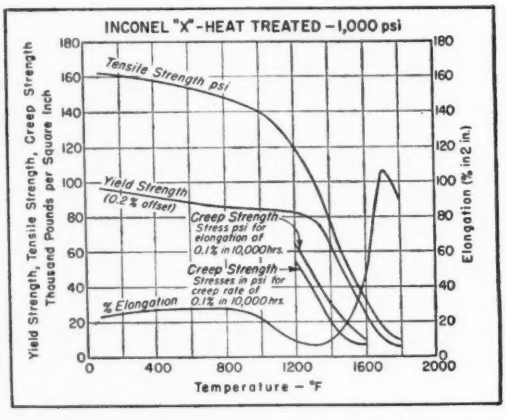
INCONEL "X"

An oxidation-resisting alloy with very high strength over 1000°F

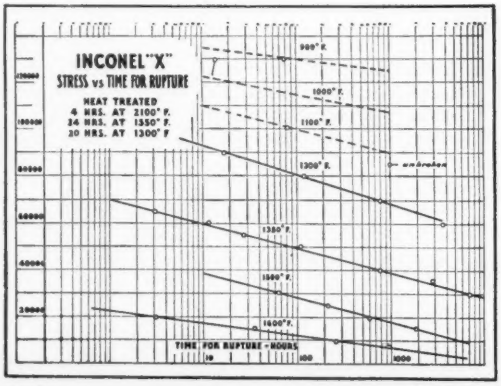
Inconel "X"® is an age-hardenable alloy which is unusually strong both at ordinary temperatures and at red heat. Suitably heat-treated, Inconel "X" has low creep rate under high stresses over 1000°F—and exceptionally high spring properties up to 1100°F.

The principal engineering characteristics of Inconel "X" (besides those shown on accompanying charts) are:

- **Oxidation Resistance**—Tests indicate that oxidation resistance of Inconel "X" is of the same order as that of Inconel.
- **Fatigue Strength**—Measurements of fully heat-treated Inconel "X" on rotating beam machines, at 100,000,000 cycles, show fatigue strengths ranging from 55,000 psi at 1200°F to 36,000 psi at 1500°F.



Short-time high-temperature properties of fully heat-treated Inconel "X".



High-temperature stress-to-rupture properties of fully heat-treated Inconel "X".

- **Impact Strength**—For fully heat-treated Inconel "X", typical impact strength values are: 33 ft. lbs. at −320°F, 37 ft. lbs. at room temperature, 67 ft. lbs. at 1500°F, and 113 ft. lbs. at 1600°F.
- **Hardness**—By proper heat treatment, the room temperature hardness of Inconel "X" can be developed as desired from BHN 140 to BHN 400.
- **Spring Properties**—By a combination of heat treatment and cold working, Inconel "X" develops unusually high spring properties. For spring applications from sub-zero temperatures up to about 650°F, it is useful where otherwise unusually strong ferrous springs must be used. Up to 1100°F, Inconel "X" springs will give useful performance where few other metals can be relied on.
- **Machining**—Inconel "X" is machinable in all conditions. Because of its strength and toughness, it cannot be machined as easily as softer metals; it can, however, be machined at entirely satisfactory rates.
- **Forging**—No unusual difficulties are encountered in forging Inconel "X", though heavier equipment than that used on ordinary steels is required.
- **Welding**—Inconel "X" can be welded by nearly all commonly used methods including: metal arc, inert gas metal arc, atomic hydrogen arc, resistance spot and seam, resistance butt welding. In common with other age-hardenable alloys, proper controls must be exercised over welding procedures. It is suggested that Inco's Technical Service section be contacted for recommendations on special jobs.
- **Applications**—Inconel "X" is used in gas turbine rotor wheels, blades; heavily stressed bolts; expansion bellows; valve springs in resonant jet engines . . . wherever a combination of high stress and extreme heat must be met.
- **Forms Produced**—Inconel "X" is supplied in most commonly used mill forms—billets, rod, flats, rounds, hexagons, sheet, strip, bar, wire, seamless tubes, and welding rods.

FURTHER DATA AVAILABLE

Inconel "X" is now in urgent requirement for critical defense applications, and we cannot say now just how soon we will be able to supply it for normal uses again. But you can get detailed information about Inconel "X" in your return mail by writing for our 79-page reference manual "Inconel 'X'" Data and Information.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE

NICKEL (INCO) ALLOYS

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"®

analysis) approach to the boundary-value problem in analyzing the supersonic flow over a low-aspect-ratio rectangular wing.

Drag of a Finite Wedge at High Subsonic Speeds. Julian D. Cole. *Journal of Mathematics and Physics*, Vol. 30, No. 2, July, 1951, pp. 79–93, illus. 14 references. Approximate method for obtaining the pressure drag at subsonic free-stream Mach Numbers close to unity; brief analysis of the exact boundary-value problem.

A Lift-Cancellation Technique in Linearized Supersonic-Wing Theory. Harold Mirels. (*U.S., N.A.C.A., Technical Note No. 2145*, 1950.) *U.S., N.A.C.A., Report No. 1004*, 1951. 11 pp., illus. 15 references. Superintendent of Documents, Washington. $0.20.

Preliminary Tests at Transonic Speeds of a Model of a Constand-Chord Wing with a Sweepback of 45° and an NACA $65_{(12)}$-210, a = 1.0 Airfoil Section. John A. Zalovcik and Richard E. Adams. *U.S., N.A.C.A., Advance Confidential Report No. L5J16a (Declassified)*, December, 1945. 21 pp., illus. 5 references.

An Investigation of the Low-Speed Stability and Control Characteristics of Swept-Forward and Swept-Back Wings in the Ames 40- by 80-Foot Wind Tunnel. Gerald M. McCormack and Victor I. Stevens, Jr. *U.S., N.A.C.A., Research Memorandum No. A6K15*, June 10, 1947. 173 pp., illus. 8 references.

Data from tests on wings with sweep angles of ±45°, ±30°, and 0° at angles of sideslip varying from −10° to +5°. Airfoil sections of the wing varied from N.A.C.A. 0015 at the root to N.A.C.A. 23009 at the tip. Each wing was tested with undeflected flaps, partial-span split flaps deflected 60°, full-span split flaps deflected at 60°, and 0.20-chord split-flap-type ailerons deflected at ±15°. $C_{L(max)}$ was measured at $R = 5.7 \times 10^6$ to $R = 9.2 \times 10^6$. Results are compared with theoretical predictions of the effect of sweep on the aerodynamic parameters and on aircraft performance and stability.

Effect of Ground Interference on the Aerodynamic Characteristics of a 42° Sweptback Wing. G. Chester Furlong and Thomas V. Bollech. *U.S., N.A.C.A., Research Memorandum No. L8F04*, September 7, 1948. 27 pp., illus. 6 references.

Effects of Several Leading-Edge Modifications on the Stalling Characteristics of a 45° Swept-Forward Wing. Gerald M. McCormack and Woodrow L. Cook. *U.S., N.A.C.A., Research Memorandum No. A9D29*, June 14, 1949. 46 pp., illus. 4 references.

An Investigation of the Effect of Tip Shape on the Low-Speed Aerodynamic Characteristics of Large-Scale Swept Wings. Walter C. Walling. *U.S., N.A.C.A., Research Memorandum No. A7H13*, November 13, 1947. 18 pp., illus. 1 reference.

Preliminary Investigation at Low Speeds of Swept Wings in Rolling Flow. David Feigenbaum and Alex Goodman. *U.S., N.A.C.A., Research Memorandum No. L7E09*, May 22, 1947. 17 pp., illus. 7 references.

Preliminary Investigation at Low Speeds of Swept Wings in Yawing Flow. Alex Goodman and David Feigenbaum. *U.S., N.A.C.A., Research Memorandum No. L7I09*, February 4, 1948. 22 pp., illus. 6 references.

Aerodynamics of the Delta. J. R. Ewans. *Flight*, Vol. 60, No. 2220, August 10, 1951, pp. 172–174, illus. Advantages of the delta wing over the conventional wing for high-speed aircraft; effects on drag-rise Mach Number; "tailless" delta-wing aircraft.

Flight Characteristics at Low Speed of Delta-Wing Models. Marion O. McKinney, Jr., and Hubert M. Drake. *U.S., N.A.C.A., Research Memorandum No. L7KO7*, January 13, 1948. 33 pp., illus. 7 references.

Effect of Taper Ratio on the Low-Speed Rolling Stability Derivatives of Swept and Unswept Wings of Aspect Ratio 2.61. Jack D. Brewer and Lewis R. Fisher. *U.S., N.A.C.A., Research Memorandum No. L8H18*, November 9, 1948. 19 pp., illus. 6 references.

Langley Full-Scale-Tunnel Investigation of the Maximum Lift and Stalling Characteristics of a Trapezoidal Wing of Aspect Ratio 4 with Circular-Arc Airfoil Sections. Roy H. Lange. *U.S., N.A.C.A., Research Memorandum No. L7H19*, October 17, 1947. 28 pp., illus. 5 references.

Aeroelasticity

Analysis of Pure-Bending Flutter of a Cantilever Swept Wing and Its Relation to Bending-Torsion Flutter. H. J. Cunningham. *U.S., N.A.C.A., Technical Note No. 2461*, September, 1951. 24 pp., illus. 3 references.

Analysis of pure-bending flutter and of the effects of wing mass-density ratio, length-semichord ratio, sweepback angle, and Mach Number on flutter in bending alone for a cantilever wing.

Wing Flexure-Aileron Flutter Tests on a Model of B.A.C. Wing Type 167. G. Scruton. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2480*, 1951 (October 16, 1944). 19 pp., illus. 2 references. British Information Services, New York. $1.25. Test procedure and results on a flexurally-geared aileron control system.

An Experimental Investigation of the Effect of Localised Masses on the Flutter of a Model Wing. N. C. Lambourne and D. Weston. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2533*, 1951 (April 12, 1944). 28 pp., illus. 4 references. British Information Services, New York. $1.25. Measurements of critical speed and frequency with mass-loadings at several positions along the span and chord; modes of deformation of the wing.

The Quarter-Infinite Wing Oscillating at Supersonic Speeds. Theodore R. Goodman. *Cornell Aeronautical Laboratory, Inc., Report No. 36*, July, 1951. 6 pp., illus. 8 references. The solution is obtained using a method developed by C. S. Gardner. Results agree with Miles' and Stewartson's analyses.

Calculation of the Effects of Structural Flexibility on Lateral Control of Wings of Arbitrary Plan Form and Stiffness. Franklin W. Diederich. *U.S., N.A.C.A., Research Memorandum No. L8H24a*, December 24, 1948. 32 pp., illus. 6 references.

On Harmonic Motion of Wide Delta Airfoils at Supersonic Speeds. John W. Miles. (*U.S., Naval Ordnance Test Station, Inyokern, Calif., Technical Memorandum No. RRB-36*, February 9, 1950.) *U.S., Naval Ordnance Test Station, Inyokern, Calif., NAVORD Report No. 1234 (NOTS 294)*, June 13, 1950. 42 pp., illus. 8 references.

On the Theory of Oscillating Airfoils of Finite Span in Subsonic Compressible Flow. Eric Reissner. (*U.S., N.A.C.A., Technical Note No. 1953*, 1949.) *U.S., N.A.C.A., Report No. 1002*, 1950. 9 pp. 6 references. Superintendent of Documents, Washington. $0.15.

Three Papers from Conference on "Wing and Tail-Surface Oscillations," March 6–8, 1941, Munich. I—Remarks Concerning Aerodynamically Balanced Control Surfaces. H. Söhngen. **Discussion. II—Aerodynamically Equivalent Systems for Various Forms of Control Surfaces Within the Scope of the Two-Dimensional Wing Theory.** L. Schwarz. **Discussion. III—Comparative Calculations Concerning Aerodynamic Balance of Control Surfaces.** F. Dietze. (*Lilienthal-Gesellschaft für Luftfahrtforschung, Bericht Nr. 135*, March, 1941, pp. 61–74.) *U.S., N.A.C.A., Technical Memorandum No. 1306*, August, 1951. 47 pp., illus. 6 references.

Analytical Determination of Coupled Bending-Torsion Vibrations of Cantilever Beams by Means of Station Functions. Alexander Mendelson and Selwyn Gendler. (*U.S., N.A.C.A., Technical Note No. 2185*, 1950.) *U.S., N.A.C.A., Report No. 1005*, 1951. 20 pp., illus., tables. 13 references. Superintendent of Documents, Washington. $0.25.

Effects of Chordwise Vanes on Amplitude of Tail Buffeting. Allen R. Stokke. *U.S., N.A.C.A., Research Memorandum No. L7H11*, November 10, 1947. 10 pp., illus. 3 references.

Readers' Forum: On the Unsteady Motion of a Thin Rectangular Wing in Supersonic Flow. N. Rott. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 775, 776. 9 references.

Solution for the case of a wing whose prescribed normal velocity is an arbitrary function of the time and of the chordwise ordinate of the wing and is independent of the spanwise ordinate of the wing.

Air Transportation (41)

Air Mail Pay and Air Transport in the U.S.A. Hugh Harvey. *Shell Aviation News*, No. 157, July, 1951, pp. 4–9, illus.

Brief review of Government pay for air mail; benefits to U.S. air transportation by Government-supported air-mail payments; rate-subsidy separation problem. Tables show the current air-mail pay rates, air-mail payments over the 12-month period ended June 30, 1950, Post Office air-mail revenues and payments to domestic and international carriers.

Faster gunnery for our "flat-tops"— through electronics

Constantly faster and more accurate aerial attack upon aircraft carriers can only be answered in kind. Split-second gunnery is urgently demanded – and met through the miracles of electronics. Working closely with our Armed Forces for 33 years, Arma has developed the wealth of engineering experience and production techniques that plays an outstanding part in the production of these complex, compact, accurate instruments.

ARMA CORPORATION
254 36th Street, Brooklyn 32, N.Y.
SUBSIDIARY OF AMERICAN BOSCH CORPORATION

QUALITY ARMA PRECISION
INSTRUMENT

Air Cargo Development Team. Harry E. Karst. *Air Transportation*, Vol. 19, No. 2, August, 1951, pp. 10, 27–30. Recommendations for air-cargo development in California, including cooperative action among the carriers, air-frame manufacturers, and the Government.

Airline Fares and Costs. Garret Fitzgerald. *Shell Aviation News*, No. 158, August, 1951, pp. 15–17.

Analysis of the problem of when and why to increase air-line fares, based on the principle that the justification of fare increases following cost increases depends entirely on the saving in production costs following the drop in demand caused by increased fares.

Planning Commercial Success. *The Aeroplane*, Vol. 81, No. 2090, August 10, 1951, pp. 165–167, illus. Traffic and scheduling arrangements of Aer Lingus.

Operational Aspects of Turbo-Jet Transports. R. Dixon Speas. *Aeronautical Engineering Review*, Vol. 10, No. 11, November, 1951, pp. 48–59, illus. Review of operational experience with the Avro (Canada) C.102 Jetliner; special problems in civil operation of jet transports; air-line economics.

Airplane Design (10)

Operational Aspects of Turbo-Jet Transports. R. Dixon Speas. *Aeronautical Engineering Review*, Vol. 10, No. 11, November, 1951, pp. 48–59, illus. Review of operational experience with the Avro (Canada) C.102 Jetliner; special problems in civil operation of jet transports; air-line economics.

Weight Growth of Jet Fighters. Gene A. Kunznick. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 30–31, 87–90, illus. 2 references. Statistical analysis of the extent and nature of the weight growth based on probability theory.

The Design Study. H. K. Millicer. *Flight*, Vol. 60, No. 2221, August 17, 1951, pp. 201–205, illus. 10 references.

An approximate method of preliminary design analysis in which the conventional aircraft dimensions are calculated as functions of the desired structural weight, based on specific performance requirements.

Experts Tell Why Planes Cost So Much. *Aviation Week*, Vol. 55, No. 9, August 27, 1951, pp. 23, 24, 27, 28, tables. Comparative data on the cost, engineering man-hours of development time, and engineering personnel working on the design studies of the North American F-51 and F-86 aircraft.

Ingenuity Marks French Patents; SNCASO Will License 11 Aircraft Design Features. *Aviation Week*, Vol. 55, No. 7, August 13, 1951, pp. 29, 31, 32, illus. Boundary-layer control, ramjet helicopters, nozzle variations, retractable gear, brakes, and ejection seat.

Design for Combat Maintenance. Bruce H. Pauly. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 17, 18, 52, 54, 56, illus. Design details that provide reliable components capable of withstanding the severity of combat with a minimum of maintenance time and routine.

AIRPLANE DESCRIPTIONS

A British Aircraft Reference. *Aeronautics*, Vol. 25, No. 2, September, 1951, pp. 44–62, illus., diagrs. Specifications and general performance data on British civil, military, and experimental airplanes and helicopters that were shown at the S.B.A.C. Farnborough display.

Paris and Le Bourget, 1951; A Review of the More Interesting Exhibits at the Nineteenth Salon. James Hay Stevens. *Aircraft Engineering*, Vol. 23, No. 270, August, 1951, pp. 218–227, 245, illus.

Ambrosini S.7 Single-Engined Operational Trainer, Italy. *Flight*, Vol. 60, No. 2222, August 24, 1951, pp. 224–227, illus., cutaway drawing.

Boeing B-50D Superfortress Four-Engined Bomber (Aviation Design Progress). Randolph Hawthorne. *Aviation Age*, Vol. 16, No. 2, August, 1951, pp. 28, 29, illus., cutaway drawings.

de Havilland DHC-3 King Beaver 8–14 Passenger Single-Engined Seaplane-Landplane, Canada. *Canadian Aviation*, Vol. 24, No. 8, August, 1951, pp. 16–19, illus.

de Havilland D.H. 106 Comet Four-Engined Turbojet Transport, England (Planning and Production Methods Used in the Construction of the de Havilland Comet.) H. Povey. *de Havilland Gazette*, No. 64, Supplement, August, 1951, pp. 3–33, Discussion, pp. 33–39, illus. *Royal Aeronautical Society, Journal*, Vol. 55, No. 488, August, 1951, pp. 459–514, Discussion, pp. 515–517, illus.

Lockheed F-94C Single-Engined Turbojet All-Weather Fighter. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 20–23, 72, 74, 76, 78, 80, illus., cutaway drawing.

Lockheed Super Constellation 1049B Four-Engined Cargo Aircraft. *Aviation Week*, Vol. 55, No. 10, September 3, 1951, p. 16, illus.

Martin B-57A Twin-Engined Turbojet Night-Intruder Bomber. *Aviation Week*, Vol. 55, No. 9, August 27, 1951, p. 44, cutaway drawing.

MiG-15 Bis Single-Engined Turbojet Radar-Equipped Fighter, U.S.S.R. *Aviation Age*, Vol. 16, No. 2, August, 1951, pp. 15–20, illus. Evolution of the design from the Focke-Wulf Ta-183.

Northrop F-89 Two-Engined Turbojet Fighter. *Aviation Week*, Vol. 55, No. 8, August 20, 1951, pp. 21, 22, 25, 26. Design details that simplify and speed up maintenance.

Piaggio P.148 Single-Engined Primary Trainer, Italy. *Aviation Age*, Vol. 16, No. 2, August, 1951, p. 31, illus.

Yak-14 Single-Engined Liaison Plane, U.S.S.R. *Flying*, Vol. 49, No. 4, October, 1951, pp. 22, 23, 41, illus.

CONTROL SYSTEMS

Distortion of Control Surface Panels. D. M. A. Leggett and R. G. Chapman. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2478*, 1951 (November, 1944). 30 pp., illus. 2 references. British Information Services, New York. $1.25.

Theoretical analysis of the distortion likely to occur with fabric-covered, dural-sheet, magnesium-sheet, and dural-balsa sandwich-constructed control surfaces for various types of aerodynamic loading; tests made on the various types of control surface.

Note on Differential Gearing As a Means of Aileron Balance. S. B. Gates. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2526*, 1951 (December, 1940). 22 pp., illus. 6 references. British Information Services, New York. $1.00.

Definition of differential gearing; analysis in relation to obtaining close balance at high speed without any overbalance throughout the speed range; some data on the geometry of differential gearing.

Efferent Systems for Aeroplanes. *Aeronautics*, Vol. 25, No. 2, September, 1951, pp. 84, 85, illus.

Diagrammatic summary of the methods of converting the pilot's actions into control-surface movements: simple aerodynamic balances, Flettner rudder, trim tabs, spring tabs, and hydraulic and electric actuators.

LANDING GEAR

Anti-Skid Braking Systems. J. H. Overholzer. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 36, 38, 42, illus.

Operation and performance of the Hytrol antiskid braking system. Developed by Boeing Airplane Co. and manufactured by Hydro-Aire, Inc., Hytrol uses a flywheel inertia mechanism as a skid detector.

Brake Energy Nomogram. British Messier Ltd. *Aircraft Engineering*, Vol. 23, No. 270, August, 1951, p. 244, illus.

WINDSHIELDS

Centrifugal Forming. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 245, 246, illus. Shaping of aircraft canopies by a centrifugal method and without forming dies.

WING GROUP

Transformable Delta Project; A Proposal by Professor G. T. R. Hill. Grenville Manton. *Flight*, Vol. 60, No. 2218, July 27, 1951, pp. 107, 108, illus.

Design of a delta-wing aircraft. A main wing that is hinged at the root and a subsidiary wing are mounted together in such a manner that the main wing can swing back to meet the subsidiary wing forming a continuous delta lifting surface. When the main wing is in the forward position, the subsidiary wing serves as a tail plane. The design provides a wide speed range.

Wing-Folding Mechanism. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 242–244, illus. Machining intricate and heavy-duty components on the Vickers-Supermarine Attacker naval fighter.

SPECIAL DELIVERY IN A RICE PADDY

Pin-point delivery in a Korean rice paddy... paratroop units with complete, fully-assembled equipment and supplies are ready for instant action... where no roads or airfields exist—tough, battle-proven Fairchild C-119's provide "Special Delivery."

Speed, stamina and versatility—key points of Fairchild engineering and design—have made the rugged, dependable "Flying Boxcars" the all-purpose transport for military airlift operations of the United Nations forces in Korea, and for other airlift operations in Europe and the United States.

ENGINE AND AIRPLANE CORPORATION

FAIRCHILD *Aircraft Division*

Hagerstown, Md., Chicago, Ill.

OTHER DIVISIONS: ENGINE, GUIDED MISSILES AND STRATOS DIVISIONS, FARMINGDALE, N. Y.

Airports (39)

Experiments in Air Traffic Control. P. F. Duncan. *The Aeroplane*, Vol. 81, No. 2092, August 24, 1951, pp. 221–224, illus. 5 references. Review of air-traffic control systems, and of simulation methods and synthetic trainers for evaluating such systems, in the United Kingdom and in the U.S.

Aluminium Alloy Hangars at London Airport. *Airports & Air Transportation*, Vol. 5, No. 89, July–August, 1951, pp. 220–222, illus.

Planning and Construction of Airfields. J. A. Dawson. *Airports & Air Transportation*, Vol. 5, No. 89, July, August, 1951, pp. 216–218. (Abstract of a paper before the Joint Conference of the Institutions of Civil, Mechanical, and Electrical Engineers.)

The Ideal Airport. Rene Lemaire. *Interavia*, Vol. 6, No. 4, April, 1951, pp. 180–186, illus. Factors to be considered in the design of an airport that will keep pace with changing air-traffic needs, based on present airport standards in France.

The World's Major Airports. *Interavia*, Vol. 6, No. 4, April, 1951, pp. 199–204, illus. List of 168 airports in 22 different territories. Number and position of runways, maximum runway length, and landing and lighting aids are included for each airport.

Airport Economics Still Far from Ideal. G. C. Van Wageningen. *Interavia*, Vol. 6, No. 4, April, 1951, pp. 191–194, illus. Analysis of the economic aspects of airport operation, specifically the airport landing area and excessive runway space.

A Summary Report on Soil Stabilization by the Use of Chemical Admixtures. R. C. Mainfort. *U.S., C.A.A., Technical Development Report No. 136*, February, 1951. 57 pp., illus. 10 references.

Aviation Medicine (19)

Human Factors in Jet Bomber Operation. D. C. Heimburger. *Journal of Aviation Medicine*, Vol. 22, No. 4, August, 1951, pp. 312–315. Fatigue and anxiety factors, escape hatches, and factors that limit the speed at which an aircraft can be flown with reasonable assurance of escape for the crew.

Fatigue and Operations. Dale O. Smith. *Pegasus*, Vol. 17, No. 2, August, 1951, pp. 10–15, illus. 1 reference. The overall effects of fatigue of a fighter pilot or a bomber crew on individual action and unit tactics; causes and suggested remedies; effective endurance limit.

Aviation Psychology. Mamoru Mochizuki. Translated from the Japanese by Willard F. Day. *U.S., C.A.A., Division of Research, Report No. 87*, August, 1949 (December 8, 1944). 165 pp., illus. 3 references.

Development of the spirit of aviation; the sky as an environment; technique of flying; life of a pilot; communications training; the psychology of preparation for flying; safety and accidents.

Human Exposure to Linear Decelerative Forces in the Backward Facing Seated Positions. John P. Stapp. *Military Surgeon*, Vol. 109, No. 2, August, 1951, pp. 106–108.

A Recent Advance in Air Force Pressure Breathing Equipment; The Automatic Pressure Breathing Oxygen Regulator—Type D-1. Wayland E. Hull. *Journal of Aviation Medicine*, Vol. 22, No. 4, August, 1951, pp. 295–305, illus. 8 references.

Design details of a pressure-demand regulator for use at altitudes up to 50,000 ft.; requirements for emergency oxygen equipment (exposure at altitudes of 40,000 ft.) from the standpoint of immediate survival.

K-S Disposable Oxygen Mask. A. D. Tuttle, J. P. Marbarger, and U. C. Luft. *Journal of Aviation Medicine*, Vol. 22, No. 4, August, 1951, pp. 255–277, illus. 5 references.

Electronics (3)

ANTENNAS

Radio-Frequency Current Distributions on Aircraft Structures. J. V. N. Granger and T. Morita. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 932–938, illus. 6 references.

Technique for the experimental study of radio-frequency currents excited on the metal skin of an aircraft by a transmitting antenna. Current-density distributions were measured on scale models of aircraft; contour plots show the distributions for several aircraft.

The Impedance of an Antenna over a Large Circular Screen. James E. Storer. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1058–1066, illus. 8 references.

Theoretical analysis of the problem of an antenna erected vertically in the center of a circular screen; no restriction is placed on the length of the antenna. An expression is obtained for the change of antenna impedance as a function of the screen diameter which forms a criterion for determining the effective screen diameter.

Path-Length Microwave Lens; Experimental Characteristics. D. G. Kiely. *Wireless Engineer*, Vol. 28, No. 335, August, 1951, pp. 248–250, illus. 1 reference.

Approximation Methods in Radial Transmission Line Theory with Application to Horns. A. E. Laemmel, N. Marcuvitz, and A. A. Oliner. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 959–965, illus. 7 references.

A Photographic Method for Displaying Sound Wave and Microwave Space Patterns. W. E. Kock and F. K. Harvey. *Bell System Technical Journal*, Vol. 30, No. 3, July, 1951, pp. 564–587, illus. 6 references.

CIRCUITS & CIRCUIT ELEMENTS

An Introduction to Computer Concepts. II. John D. Goodell. *Radio & Television News*, Vol. 46, No. 3, September, 1951, *Radio-Electronic Engineering*, pp. 7–9, illus. Applications of digital and analog computing systems; design considerations.

An Electronic Digital Computer Using Cold Cathode Counting Tubes for Storage. I. R. C. M. Barnes, E. H. Cooke-Yarborough, and D. G. A. Thomas. *Electronic Engineering*, Vol. 23, No. 282, August, 1951, pp. 286–291, illus. 11 references.

An Electrostatically Induced Permanent Memory. Charles F. Pulvari. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1039–1044, illus. 14 references. Application of ferroelectric materials as an electrostatic memory; pertinent properties of the barium titanates; experimental data obtained at 205 kc.

A Pulse Mixing Unit. Robert R. Rathbone. *Radio & Television News*, Vol. 46, No. 3, September, 1951, *Radio-Electronic Engineering*, pp. 10, 11, 27, illus. Input from up to eight external lines may be mixed producing a chain of pulses at a single output.

Bridged-Tee Phase Modulators. *Electronics*, Vol. 24, No. 9, September, 1951, pp. 268, 270, 272, 275, illus.

Bridged-tee phase-shifting circuits for low-level applications in which relatively high attenuation does not cause serious power loss. Diagrams show circuits for producing phase shift by varying either capacitance or frequency of signal, resistance, and voltage.

The Transfer Function of an R-C Ladder Network. Aaron Fialkow and Irving Gerst. *Journal of Mathematics and Physics*, Vol. 30, No. 2, July, 1951, pp. 49–72, illus. 3 references.

Cathode-Follower Input Impedance; Effect of Capacitive Load. J. E. Flood. *Wireless Engineer*, Vol. 28, No. 335, August, 1951, pp. 231–239, illus. 6 references.

Transfer Properties of Single- and Coupled-Circuit Stages with and Without Feedback. Joachim W. Muehlner. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 939–945, illus. 5 references.

Internal Resonance in Circuits Containing Nonlinear Resistance. Robert E. Fontana. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 945–951, illus. 9 references.

Waveform Systems and "Time Equalizers"; Their Transmission Characteristics. D. C. Espley. *Wireless Engineer*, Vol. 28, No. 335, August, 1951, pp. 251–258, illus. 4 references.

Network Design Charts. T. U. Foley. *Electronics*, Vol. 24, No. 9, September, 1951, pp. 132, 134, illus.

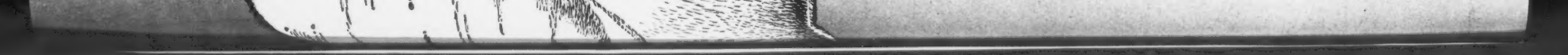
Time-saving T, pi, and L network design charts covering all normally encountered phase shifts and transformation ratios. Scale multiplying factors are eliminated by normalizing the input and output impedances being matched.

Application of Matrices to Four Terminal Network Problems. H. P. Biggar. *Electronic Engineering*, Vol. 23, No. 282, August, 1951, pp. 307–309, illus.

COMMUNICATIONS

Transatlantic Radio Road. D. West. *Aeronautics*, Vol. 25, No. 1, pp. 22–28, illus.

Radio equipment and usage in the North Atlantic on a flight from London to Montreal via Prestwick (Scotland) and Keflavik



For these hands anything is possible...

These are the hands of industry — the hands that built America — the hands of skilled workmen. Here at Eclipse-Pioneer these hands... at drill-presses, at lathes, in laboratories, at drawing boards... have helped accomplish the miracle of modern aviation. Working at design, development and production — these are the hands that assist you when you call on Eclipse-Pioneer to produce the instruments and accessories for your planes. Backed by our research facilities... equipped with every tool of modern production... these hands will work as your own to create ever finer aircraft for the civil and military needs of the free world.

ECLIPSE-PIONEER DIVISION OF Bendix AVIATION CORPORATION

TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

(Iceland) in a B.O.A.C. Stratocruiser; facilities aboard the aircraft; ground stations; weather ships.

COMPONENTS

Piezoelectric Crystals As Sensing Elements of Pressure, Temperature, and Humidity. E. A. Roberts and Paul Goldsmith. *Electrical Engineering*, Vol. 70, No. 9, September, 1951, pp. 776–780, illus. Methods of using the crystals and associated electronic circuits.

Metallized-Paper Capacitors. *Aerovox Research Worker*, Vol. 21, Nos. 6–8, June–August, 1951, pp. 1–11, illus. 15 references. Characteristics and operating conditions; manufacturing processes; applications; construction and performance of P83Z "microminiatures."

The Testing of Fine Wires for Telecommunication Apparatus. R. C. Woods and J. K. Martin. (*I.E.E., Measurements Section, Paper No. 1064.*) *Institution of Electrical Engineers, Proceedings, Part II, Power Engineering*, Vol. 98, No. 64, August, 1951, pp. 529–536, Discussion, pp. 536–539, illus. 2 references.

Standards on Transducers: Definition of Terms, 1951 (Standard 51 IRE 20 S2). *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 897–899.

CONSTRUCTION TECHNIQUES

Microwave Printed Circuits. R. M. Barrett and M. H. Barnes. *Radio & Television News*, Vol. 46, No. 3, September, 1951, *Radio-Electronic Engineering*, pp. 16, 31, illus. Adaptation of the planar transmission system to microwave printed circuits; testing the capacity of the printed strip; applications.

Winding Space Determination. N. H. Crowhurst. *Electronic Engineering*, Vol. 23, No. 282, August, 1951, pp. 302–306, illus. Charts for calculating the space occupied by a specific number of turns, using various wire types and gages.

ELECTRONIC CONTROLS

Radio Telearchics. *Wireless World*, Vol. 57, No. 9, September, 1951, pp. 342–346, illus. Principles of radio control systems; types of systems; sample circuits; applications.

ELECTRONIC TUBES

Charge Storage in Cathode-Ray Tubes. C. V. Parker. (*U.S., Naval Research Laboratory, Washington, Report No. 3648*, March 17, 1950.) *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 900–907, illus. 10 references.

Approximate analysis of the charging process and of the effects of the parameters on the output current. Four phases of the process are studied: spot charging with and without redistribution, and scanning with and without redistribution.

The Calculation of Traveling-Wave-Tube Gain. C. C. Cutler. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 914–917, illus. 5 references.

MEASUREMENTS & TESTING

A Sample Holder for Solid Dielectric Materials. Ivan G. Easton. *General Radio Experimenter*, Vol. 26, No. 3, August, 1951, pp. 1–5, illus. 1 reference. Design and performance of Type 1690-A Dielectric Sample Holder, a Hartshorn micrometer-type holder for use in the frequency range from 0.1 to 100 mc.

Self-Balancing Microwave Power Measuring Bridge. L. A. Rosenthal and J. L. Potter. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 927–931, illus. 9 references.

A Spectrum Recording System. A. B. Todd. *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest*, Vol. 16, No. 8, August, 1951, pp. 20–28, illus. 3 references.

An audio spectrum recording system for automatically analyzing and recording audio-frequency data is based on a General Radio, Type 736-A, Wave Analyzer, modified to provide automatic sweeping of the main tuning dial, a means for recording data, and automatic frequency calibration of recordings. Block and circuit diagrams show the apparatus.

NAVIGATION AIDS

Prevention of Echo Interference in Double-Pulse Coded nterrogator-Responder Systems. R. S. Styles. *Australian Journal of Applied Science*, Vol. 2, No. 1, March, 1951, pp. 26–42, illus. 8 references.

Review of the principles of operation of double-pulse selection; presentation of a method of echo suppression applicable generally to pulse-multiplex and pulse-width selection in Australian DME equipment. The method is based on an Instantaneous Automatic Gain Control technique and demonstrated in tests at two sites near Sydney, Australia.

Correspondence: Polarization Errors of Radio Direction Finders, a Proposed Classification. Paul G. Hansel. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, p. 970.

NOISE & INTERFERENCE

Noise in Traveling-Wave Tubes. F. N. H. Robinson and R. Kompfner. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 918–926, illus. 13 references.

Gaseous Discharge Super-High-Frequency Noise Sources. Harwick Johnson and K. R. Deremer. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 908–914, illus. 12 references.

Expected Number of Crossings of Axis by Linearly Increasing Function Plus Noise. Frank W. Lehan. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1067–1069, illus. 2 references. Graphic solution of the generalized problem of determining the number of times per sec. that a random noise voltage crosses a fixed arbitrary reference level.

RADAR

Miniature Radar Transponder Beacon. R. S. Butts. *Electronics*, Vol. 24, No. 9, September, 1951, pp. 104–107, illus.

Design and operation of a radar beacon for pilotless aircraft which transmits information automatically when interrogated so that the azimuth, range, and identification of the craft can be determined. The beacon consists of a receiver tuned-filter cavity, a video receiver, a pulse transmitter, and a power supply. The receiver is responsive to interrogating pulses of 1.0 μsec. or longer. The equipment can operate at ambient temperatures from −40° to +75°C. and up to altitudes of 60,000 ft.

TRANSMISSION LINES

Some Circuit Properties and Applications of *n-p-n* Transistors. R. L. Wallace, Jr., and W. J. Pietenpol. (*Institute of Radio Engineers, Proceedings*, Vol. 39, No. 7, July, 1951, pp. 767–782.) *Bell System Technical Journal*, Vol. 30, No. 3, July, 1951, pp. 530–563, illus. 5 references. Circuit aspects of the *n-p-n* transistor based on an analysis of the performance data of a few experimental units.

$TM_{1,1}$ Waves in Rectangular Wave Guides. *Radio & Television News*, Vol. 46, No. 3, September, 1951. *Radio-Electronic Engineering*, p. 32, illus. Nomograph for determining the cut-off frequency when the dimensions of the guide are given.

A Study of Single-Surface Corrugated Guides. Walter Rotman. *Institute of Radio Engineers, Proceedings*, Vol. 39, No. 8, August, 1951, pp. 952–959, illus. 16 references.

Microwave Filters Employing a Single Cavity Excited in More Than One Model. Wei-Guan Lin. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 989–1001, illus. 7 references.

Reduction of Skin Effect Losses by Use of Laminated Conductors. A. M. Clogston. *Bell System Technical Journal*, Vol. 30, No. 3, July, 1951, pp. 491–529, illus. 1 reference.

WAVE PROPAGATION

Long Distance Scattering of Radio Signals. S. S. Banerjee and V. D. Rajan. *Journal of Scientific and Industrial Research*, Vol. 10B, No. 7, July, 1951, pp. 161–164, illus. 6 references. Analysis of observations on the long-distance scattering in the 31-m. band.

On a Method of Preventing the Ground-Reflected Wave Effect in Rawin Observation. K. Naito. *Papers on Meteorology and Geophysics*, Vol. 2, No. 1, March, 1951, pp. 76–84, illus. 8 references. Prevention of ground-reflected waves by placing a conductive plane screen of the knife-edge type in front of the receiving antenna.

The Ionospheric Polarization of Low-Frequency Radio Waves. John M. Kelso. *Journal of Scientific & Industrial Research*, Vol. 10B, No. 6, June, 1951, pp. 123–133, illus. 9 references.

On tough sealing jobs like this...

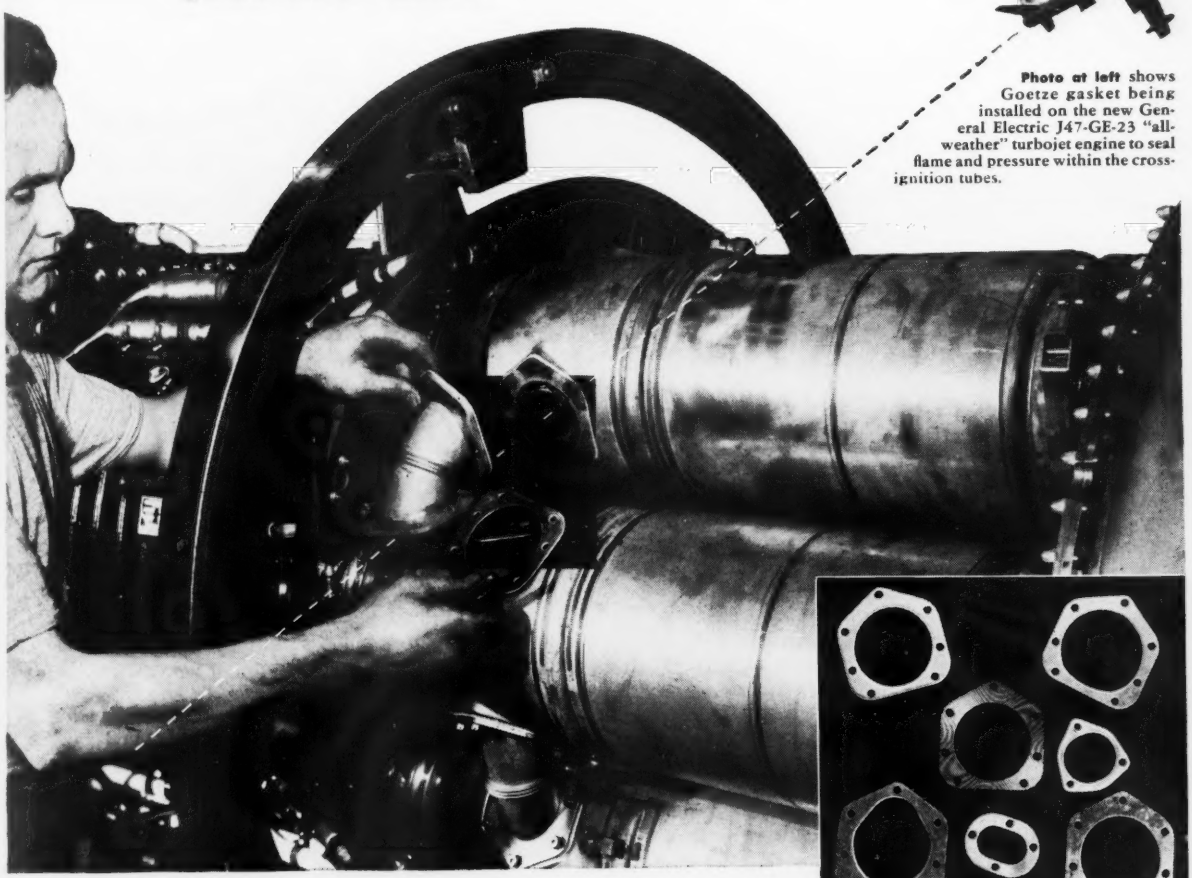
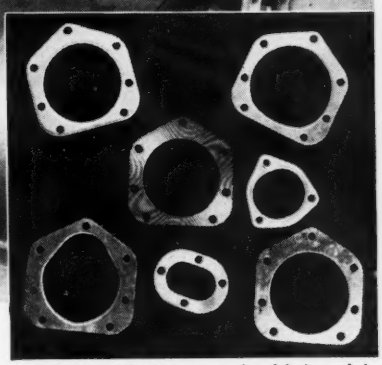


Photo at left shows Goetze gasket being installed on the new General Electric J47-GE-23 "all-weather" turbojet engine to seal flame and pressure within the cross-ignition tubes.



J-M Goetze Gaskets can be fabricated in any shape for sealing cross-ignition tube connections. A few examples are shown here.

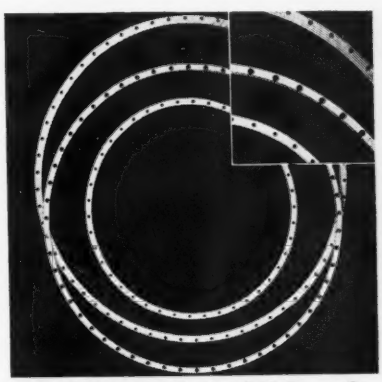
J-M Goetze Gaskets guard against critical flame and pressure leakage

Keeping flame and pressure from leaking where cross-ignition tubes connect combustion cans on the new J47-GE-23 "all-weather" turbojet engine is a typical example of the difficult and critical sealing problems that are solved with Goetze custom-crafted metallic gaskets.

The particular Goetze style used for this job is a metal-jacketed asbestos gasket, precision-made to fit tight and stay tight in service. It withstands temperatures to 850F and all operating pressures normally encountered in this type of service. Its flexibility protects against vibration, expansion and contraction.

Like all Goetze gaskets, this style is backed by more than 60 years of Goetze "know-how" that has solved many of industry's most complex sealing problems with gaskets of every design, shape, and size. And it is made on the same modern machines that enable Goetze craftsmen to fill every order with remarkable promptness.

For further information about Johns-Manville Goetze gaskets . . . and other J-M products for the aviation industry . . . write for Brochure AV-1A. Address Johns-Manville, Box 290, New York 16, New York. In Canada, write 199 Bay Street, Toronto 1, Ontario.



For turbine casing flanges J-M Goetze Gaskets provide the resilience required to overcome warpage usually encountered.

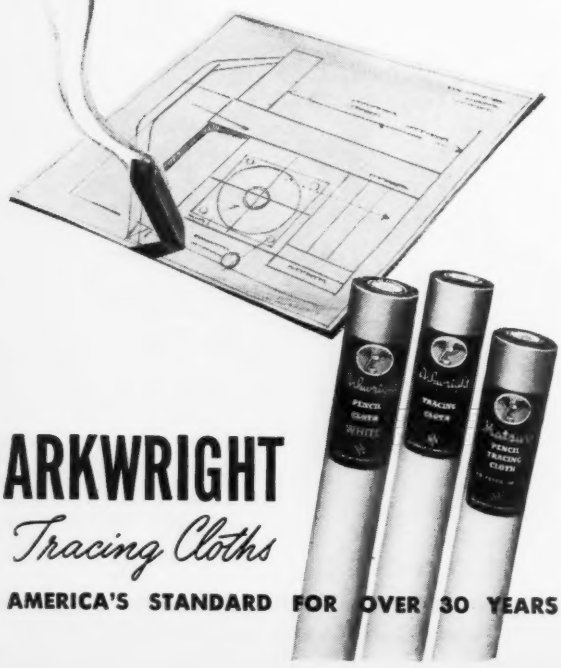
JOHNS-MANVILLE JM PRODUCTS **Johns-Manville** PRODUCTS for the AVIATION INDUSTRY

HOW TO KEEP CLEAR OF ERASURE "GHOSTS"

Specify Arkwright Tracing Cloth, and you'll get clean, clear, "ghost-free" blueprints no matter how often you erase the drawing.

You can re-ink razor-sharp lines on Arkwright Cloth without "feathering" or "blobbing". More important, you can be sure that drawings will never become brittle, opaque or paper-frayed with age.

They're good reasons for you to remember: if your work is worth saving, put it on Arkwright Tracing Cloth. Want a sample? Write Arkwright Finishing Co., Industrial Trust Bldg., Providence, R. I.



ARKWRIGHT
Tracing Cloths
AMERICA'S STANDARD FOR OVER 30 YEARS

USE PITTSBURGH
TAPES

for better cabin-sealing, float-sealing, spotweld-sealing and to prevent corrosion!

- To help you handle with greater speed and efficiency the problems presented by modern airplane manufacturing methods, Pittsburgh offers you these three important developments in sealing—
- **FABSEAL**—an impregnated fabric that forms a complete seal between metal, wood or fiber members.
- **NU-CHROMSEAL**—a solid, pliable compound in a film of fixed thickness for sealing lap joints or butt seams in metal, wood or fiber where rivets, bolts or screws are used. Seals water, gasoline or oil storage compartments. Insulates dissimilar metals to prevent corrosion. Stops squeaks or chafing where metal parts rub against each other.
- **WELDSEAL**—protects spot-welded and hot-riveted assemblies from corrosion by sealing seams against moisture. Flows around heated areas and returns to original character at normal temperature.
- Samples of these remarkable tapes are available for experimental work and the services of our engineers are at your disposal for consultation without cost or obligation.

Pittsburgh also offers dopes, lacquers, primers, enamels, and special coatings for every aviation need.

PITTSBURGH PLATE GLASS COMPANY
Industrial Paint Division, Pittsburgh, Pa.

Factories: Milwaukee, Wis.; Newark, N. J.; Springdale, Pa.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Paint & Varnish Co., Dayton, Ohio. Forbes Finishes Div., Cleveland, Ohio. M. B. Suydam Div., Pittsburgh, Pa.

PITTSBURGH *Industrial* FINISHES
PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS
PITTSBURGH PLATE GLASS COMPANY

Letters to the Editor: Intensity of Scattered Radio Signals from Distant Transmitters. S. S. Banerjee, V. D. Rajan, and R. R. Mehrotra. *Journal of Scientific & Industrial Research*, Vol. 10B, No. 7, July, 1951, pp. 172, 173, illus. 2 references.

Equipment

ELECTRIC (16)

A.C. System Protection. R. H. Keith. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 26, 99–108, illus. Fault protection methods in aircraft systems.

Unit Controls Jet Starter Current. *Aviation Week*, Vol. 55, No. 10, September 3, 1951, pp. 38, 39, illus.

The Bendix Ground Power Supply Generator and Control automatically limits the current and voltage supplied to the starter to a predetermined value. Starter torque is held steady.

HYDRAULIC (20)

Determination of Ignition Characteristics of Hydraulic Fluids. I—Simulated Flight and Crash Conditions. II—Flammability Reference Scale. J. J. Gassmann. *U.S., C.A.A., Technical Development Reports Nos. 64, 142*, April, May, 1951. 10, 9 pp., illus. Tests on seven hydraulic fluids to compare the ignition characteristics of standard and proposed less flammable types of hydraulic fluids.

Nonflammable Hydraulic Fluids. Fred O. Hosterman. *Applied Hydraulics*, Vol. 4, No. 9, September, 1951, pp. 66–68, 70, 71, illus. Summary of development trends in the studies of water-base fluids, phosphate esters, silicones, and halogenated materials.

Experimental Testing of Aircraft Hydraulic Systems. Franklyn B. Cole, Jr. *Applied Hydraulics*, Vol. 4, No. 8, August, 1951, pp. 50–52, 54, 55, illus. Review of military specifications on high- and low-temperature requirements for aircraft hydraulic equipment; suggested test procedures and equipment.

Tendencies in the Hydraulic Controls and Undercarriage Industry. Rene Lucien. *Interavia*, Vol. 6, No. 8, August, 1951, pp. 455–459, illus.

Design trends to simple and more reliable hydraulic systems and landing gear, safety devices, hydraulic pressure increases, brake design and automatic brakes, nonflammable hydraulic fluids.

"Floating" Gland Design for Long "O" Ring Life. Tommy J. McCuistion. *Applied Hydraulics*, Vol. 4, No. 9, September, 1951, pp. 59, 60, 90, 91, illus.

Factors affecting "O"-ring life; design and applications of a "floating gland" for increased ring life. The design uses an "O" ring having an inside diameter that is larger than the root diameter of the groove; this prevents squeezing of the ring between the bottom of the groove and the opposite moving cylinder wall.

Designing Hydraulic Dampers with Radial-Orifice Damping Valves. William E. Soong. *Machine Design*, Vol. 23, No. 8, August, 1951, pp. 109–112, illus. 3 references.

Proportionalizing Dither. Paul B. Sebring. *Machine Design*, Vol. 23, No. 8, August, 1951, pp. 125–128, illus. 2 references.

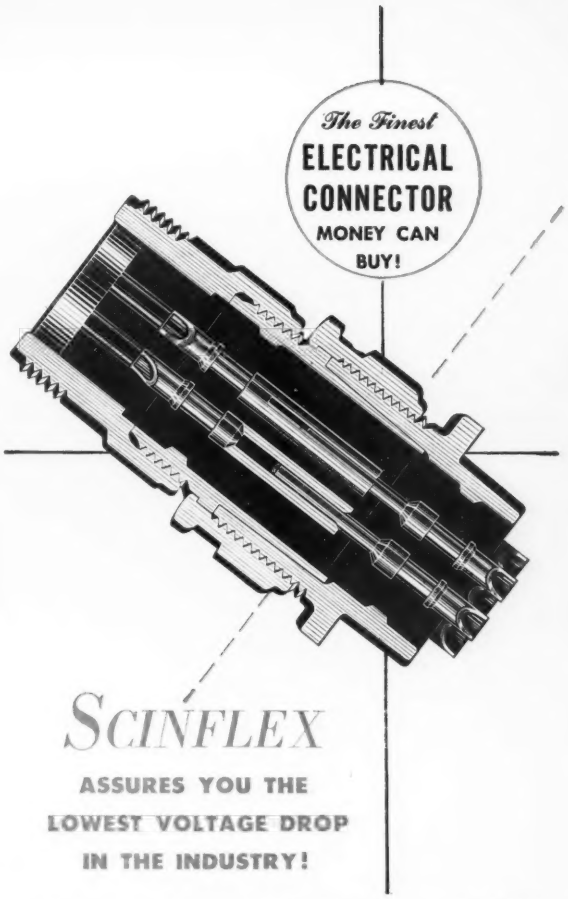
Theory of linearizing an on-off system by inserting a proportionalizing dither into the servo loop; application to an hydraulic system that uses simple on-off solenoid-operated spring-released reversing valves.

Flight Safety & Rescue (15)

Prevention of Injuries Due to Crash. Henry A. Schroeder. *Journal of Aviation Medicine*, Vol. 22, No. 4, August, 1951, pp. 306–311. 1 reference.

Survey of crash fatalities in civil and military aircraft due to decelerative forces that tore the individual and his seat loose, either or both, and hurled him against other structures. Recommended are: seats stressed to withstand approximately 40*g*, shoulder harnesses, and backward-facing seats in transports.

Pilot Escape from Spinning Airplanes As Determined from Free-Spinning-Tunnel Tests. Stanley H. Scher. *U.S., N.A.C.A., Research Memorandum No. L8D28*, September 9, 1948. 44 pp., illus. 7 references.



When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength remains well above extreme requirements within the temperature range of −67°F to +275°F. It makes possible a design increasing resistance to flashover and creepage. It withstands maximum conditions of current and voltage without breakdown. But that is only part of the story. It's also the reason why they are vibration-proof and moisture-proof. So, naturally, it pays to specify Bendix Scinflex Connectors and get this extra protection. Our sales department will be glad to furnish complete information on request.

• Moisture-Proof • Radio Quiet • Single Piece Inserts • Vibration-Proof • Light Weight • High Insulation Resistance • High Resistance to Fuels and Oils • Fungus Resistant • Easy Assembly and Disassembly • Fewer Parts than any other Connector • No additional solder required.

BENDIX SCINFLEX
ELECTRICAL CONNECTORS

Bendix

SCINTILLA MAGNETO DIVISION of
SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FACTORY BRANCH OFFICES: 118 E. Providencia Ave., Burbank, Calif. • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Michigan • Brouwer Bldg., 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

Flight Testing (13)

Autopilot Flight Tests on the Constellation. R. L. Thoren and W. L. Howland. *Aeronautical Engineering Review*, Vol. 10, No. 11, November, 1951, pp. 31–38, illus. 6 references.

Fuels & Lubricants (12)

The Oxidation, Decomposition, Ignition, and Detonation of Fuel Vapors and Gases. XVIII—The Operation of a Carburetor Type Engine by Compression Ignition with Diethyl Ether or Acetaldehyde As the Fuel. R. O. King, E. J. Durand, and A. B. Allan. *Canadian Journal of Technology*, Vol. 29, No. 8, August, 1951, pp. 382–390, illus. 10 references.

Synthesis, Purification, and Physical Properties of Hydrocarbons of the Napthalene Series. I—1-Methylnaphthalene, 1-Ethylnaphthalene, 1-Butanaphthalene, and 1-Isobutylnaphthalene. Harold F. Hipsher and Paul H. Wise. *U.S., N.A.C.A., Technical Note No. 2430*, August, 1951. 19 pp., illus. 27 references.

Correlation of Physical Properties with Molecular Structure for Some Dicyclic Hydrocarbons Having High Thermal-Energy Release per Unit Volume. P. H. Wise, K. T. Serijan, and I. A. Goodman. *U.S., N.A.C.A., Report No. 1003*, 1951. 10 pp., illus. 12 references. Superintendent of Documents, Washington, $0.15.

Viscosities of Several Fuels and Oxidants. David M. Mason, Orland W. Wilcox, and B. H. Sage. *California Institute of Technology, Jet Propulsion Laboratory, Progress Report No. 4-106*, March 20, 1951. 11 pp., illus. 11 references.

Experimental measurement of the viscosity in the liquid phase of ethylenediamine, ethylenediamine hydrate, hydrazine, isopropylamine, red fuming nitric acid, white fuming nitric acid, and furfuryl alcohol.

Guided Missiles (1)

Aero Digest Scientific Review: Guided Missile Friction Heating. Robert McLarren. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 27–29, 80, 82, 84, 86, illus. 19 references.

Evolution of the Guided Missile. V—The New Instrument. VI—The Interplanetary Project. Kenneth W. Gatland. *Flight*, Vol. 60, Nos. 2218, 2219, July 27, August 3, 1951, pp. 113–116; 140–143, illus. 5 references.

V. Rockets as instrument carriers for high-altitude research; design and characteristics of close-orbit earth-satellite vehicles. **VI.** Rocket designs for interplanetary flight; design of an orbital space vehicle.

Star-Tracking Missiles. J. G. Strong. *The Aeroplane*, Vol. 81, No. 2092, August 24, 1951, pp. 122–215, illus.

Application of star-guidance to missile control. Gyroscopes provide basic control of the missile. A telescopic device within the control mechanism, preset to follow a specific star path, is used to monitor the missile flight. The missile is kept heading in the direction of the star, not along the star beam, but parallel to the ground at a predetermined height. Since this system is not electronic, it cannot be affected by jamming.

Instruments (9)

Analysis of Systems for Automatic Control of Aircraft. James B. Rea. *Aeronautical Engineering Review*, Vol. 10, No. 11, November, 1951, pp. 39–47, 60 illus. 14 references.

Review of the growth of automatic control systems and of numerical and mechanical methods of dynamic analysis of automatic control systems; fundamental concepts; evaluation.

Multiple Mode Operation of Servomechanisms. Donald McDonald. (*American Institute of Electrical Engineers, Great Lakes National Meeting, Madison, Wis.*, May 17, 1951.) *Cook Electric Company, Cook Research Laboratories Division, Bulletin No. S-3*, 1951. 19 pp., illus. 1 reference. Multiple modes of operation of conventionally designed servomechanisms; design of a controller that will give optimum performance for each of the modes of the system.

Readers' Forum: A Simple Graphical Method for Constructing Families of Nyquist Diagrams. Robert M. Stewart. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 767, 768, illus. 1 reference.

Gyro Pickoff Indications at Arbitrary Plane Attitudes. Leonard Becker. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 718–724, illus.

Calculation of the effects of significant deviations of the aircraft from a level flight path on the pickoff readings of a set of vertical and directional position gyros; gyro interactions that affect stability.

Autopilot Flight Tests on the Constellation. R. L. Thoren and W. L. Howland. *Aeronautical Engineering Review*, Vol. 10, No. 11, November, 1951, pp. 31–38, illus. 6 references.

Determining the effect of an autopilot installation on various types of failure. A table gives the types of failures in which an autopilot can effect unusual accidental maneuvers, such as dives at excessive speeds. Flight tests were made at 271 m.p.h. to obtain time histories of maneuvers resulting from autopilot malfunctions and of devices to overcome the failures.

The Standard-Sunbury Engine Indicator "Mark 6." I, II. E. S. L. Beale and R. Stansfield. *The Engineer*, Vol. 192, Nos. 4986, 4987, August 17, 24, 1951, pp. 215–217; 246–248, illus. Design, performance, and uses of the engine indicator; improvements over earlier design; pickup units, amplifier controls, and electric circuits.

The V-*g* Recorder Gust Investigation. C. V. G. Usher. *Aircraft Engineering*, Vol. 23, No. 270, August, 1951, pp. 235–237, illus. Details of operation; type of record; recording gusts; conclusions drawn from use of the V-*g* recorder. A table lists the air-speed and acceleration ranges of the six recorder types.

Electrical Remote Indication. C. Williams. *Shell Aviation News*, No. 158, August, 1951, pp. 7–10, illus.

Applications of electric remote indicators that operate on the Desynn system, a d.c. synchronous system; on the Aysynn system, an a.c. synchronous system operating from a 26-v. 400-cycle power supply; and on the Signal Aysynn system.

Measurements of Static and Total Pressure Throughout the Transonic Speed Range As Obtained from an Airspeed Head Mounted on a Freely Falling Body. C. W. Mathews and J. R. Thompson. *U.S., N.A.C.A., Research Memorandum No. L7C04a*, April 24, 1947. 5 pp., illus.

Mobile Recording System for Rocket-Motor Tests. Kenneth C. Sutherland and William H. Spalding. *California Institute of Technology, Jet Propulsion Laboratory, Memorandum No. 4-61*, December 4, 1950. 10 pp., illus. 1 reference.

Stress Analysis at Height; Strain-Gauging of Turbine Blades During Flight (by Rolls-Royce, Ltd.) *Flight*, Vol. 60, No. 2219, August 3, 1951, p. 146, illus.

Lighter-Than-Air (40)

Could the Airship Pay? L. Arthur. *Flight*, Vol. 60, No. 2222, August 24, 1951, pp. 228, 229, illus. Analysis of the economic factors involved (passenger and cargo schedules and utilization) in the commercial use of airships.

Machine Elements (14)

Design of Machine Parts Subjected to Fluctuating Combined Bending and Torsion. N. Sag. *The Engineer*, Vol. 192, No. 4985, August 10, 1951, pp. 172–176, illus. 6 references.

Analysis of the ellipse-arc criterion of failure; critical survey of experimental results with elastic material; formulation, for parts subject to fluctuating combined bending and torsion, of design equation and design methods of a type similar to those used in design for static load.

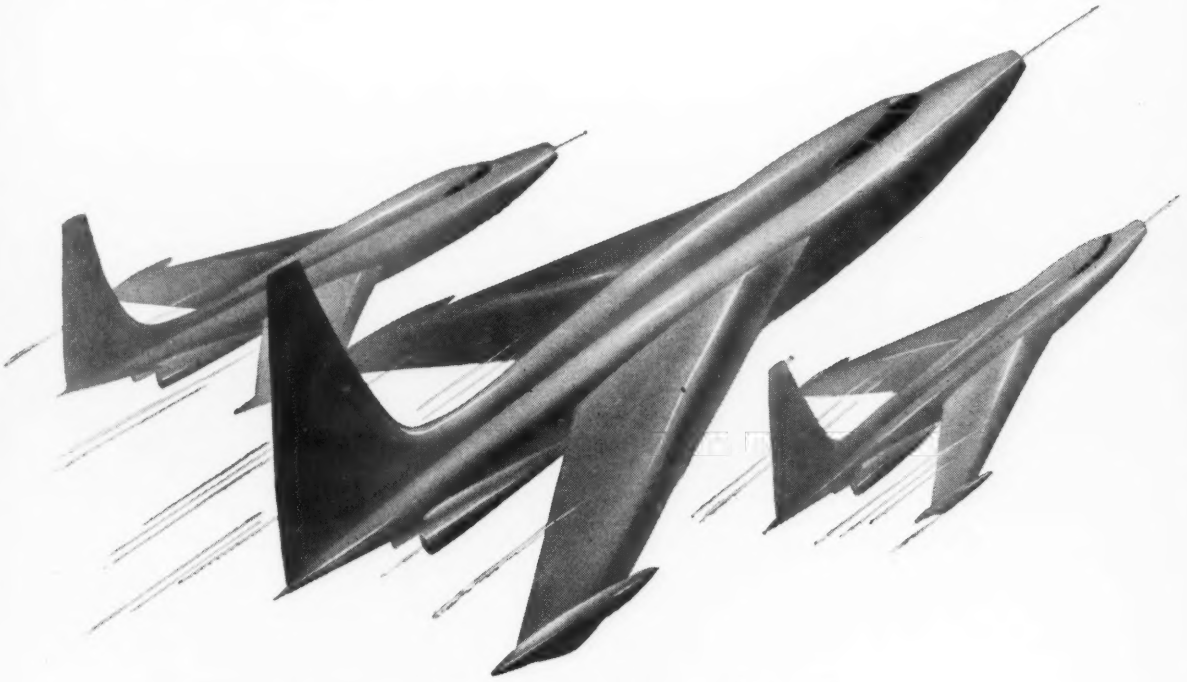
GEARS & CAMS

Nomogram Simplifies Worm and Gear Design. G. Sved. *Machine Design*, Vol. 23, No. 8, August, 1951, pp. 157–159, illus.

SHAFTS & ROTATING DISCS

Electrical Determination of Unbalance Forces in Rotors. F. Burlando. (*Rivista di Ingegneria*, Vol. 1, No. 4, April, 1951, pp. 373–379.) *Engineers' Digest*, Vol. 12, No. 8, August, 1951, pp. 261, 262, illus. Apparatus for determining the angles and magnitudes of the impressed forces. The results are presented in the form of a circular or spiral trace on a cathode-ray oscilloscope.

MAGNESIUM



IS GOING PLACES!

Magnesium, the world's lightest structural metal, has kept pace with the tremendous progress in aircraft design. In the past decade, startling design improvements have been made—improvements depending upon the inherent advantages of magnesium. Where 1,000 lb. of this ultra light metal were used in the 1940 bomber—now 15,000 to 25,000 lb. are used.

Today it is found in almost every part of these planes in the form of sheet, castings, extrusions and forgings. By this extensive use of magnesium the weight of today's bomber is as much as three and one-half tons less than it would have been had other metals been used throughout. Cutting pounds off the weight without sacrificing strength, magnesium has made possible the addition of extra features, more payload or greater flying range.

A vital metal in air transportation today, magnesium offers even greater design potentialities for tomorrow. If your aim is light weight, keep your eye on magnesium.

MAGNESIUM USED IN 1951 AIRCRAFT:

Fuselage skins
Wing skins, including de-icer system
Control surface skins
Flooring extrusions
Bomb bay doors
Propeller spinners
Waffle grid stiffeners
Formers and air ducts
Nacelle skins
Wheels, brakes, gun turrets
Radar, radio and fire control equipment
Engine castings
Airframe castings

THE DOW CHEMICAL COMPANY

Magnesium Department • *Midland, Michigan*

New York • Boston • Philadelphia • Atlanta • Cleveland • Detroit • Chicago • St. Louis • Houston
San Francisco • Los Angeles • Seattle • Dow Chemical of Canada, Limited, Toronto, Canada

Maintenance (25)

Design for Combat Maintenance. Bruce H. Pauly. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 17, 18, 52, 54, 56, illus.

Materials (8)

Pulse-Annealing for the Study of Relaxation Processes in Solids. W. E. Parkins, G. J. Dienes, and F. W. Brown. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1012–1019, illus. 6 references.

Theoretical analysis of the pulse-annealing process, its uses, and limitations. The process involves direct heating of a small sample to a specific annealing temperature for a short time, followed by rapid cooling to a specific temperature for an in-place property measurement. The process may be repeated for a time-temperature history. Apparatus and results of tests for changes in electric resistivity illustrate the process.

Refinements Aid Metal Fatigue Studies; Special Testing Units Developed at National Bureau of Standards Afford Better Control and More Speed. *Aviation Week*, Vol. 55, No. 10, September 3, 1951, pp. 21, 23, 24, illus.

Statistical Fluctuation of Intensity in Debye-Scherrer Lines Due to Random Orientation of Crystal Grains. Hans Ekstein. *U.S., N.A.C.A., Technical Note No. 2447*, August, 1951. 20 pp., illus. 3 references. Study of the fluctuations in intensity of a beam of negligible width and divergence.

CERAMICS & CERAMALS

Ceramics and Special Alloys. Wilson G. Hubbell. *Aeronautical Engineering Review*, Vol. 10, No. 11, November, 1951, pp. 24–30, illus.

Metallurgical investigation of exhaust-system components of ceramic-coated 19-9DL and other uncoated alloys. Tests were carried out under actual operating conditions (temperature of −75° to 1,700°F.) on a P.A.A. Boeing Stratocruiser in transpacific service.

Ceramic Liners. *Aviation Week*, Vol. 55, No. 7, August 13, 1951, pp. 34, 37, illus. Solar Aircraft Co. process of coating common metals with ceramics for high-temperature applications.

Ceramics for the Hot Spots. C. L. Foushee, Jr. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 32, 93–96, illus. Preparation, applications, and advantages of ceramic coatings for the engine exhaust manifolds made at Ryan Aeronautical Co.

METALS & ALLOYS

Kinetics of Sintering Chromium Carbide. W. G. Lidman and H. J. Hamjian. *U.S., N.A.C.A., Technical Note No. 2491*, August, 1951. 16 pp., illus. 6 references. Investigation of the kinetics of densification and grain growth during the sintering of Cr_3C_2 under pressure.

Knitted Metal Parts Have Unique Industrial Applications. S. G. Kelley, Jr. *Materials & Methods*, Vol. 34, No. 2, August, 1951, pp. 61–63, illus. Properties and applications of knitted mesh.

Investigation of Torsion Creep-to-Rupture Properties of N-155 Alloy. C. W. MacGregor and F. J. Walcott, Jr. *U.S., N.A.C.A., Research Memorandum No. 51E04*, August 21, 1951. 26 pp., illus. 5 references. Results of rupture tests in the 10- to 1,000-hour range at temperatures of 1,200°, 1,350°, and 1,500°F.

Fundamental Effects of Aging on Creep Properties of Solution-Treated Low-Carbon N-155 Alloy. D. N. Frey, J. W. Freeman, and A. E. White. (*U.S., N.A.C.A. Technical Note No. 1940, 1949.*) *U.S., N.A.C.A., Report No. 1001*, 1950. 30 pp., illus. 13 references. Superintendent of Documents, Washington. $0.25.

The Surface Hardening of Steel. I—Methods and Practices. II—Mechanism of the Carburising Process and the Effect of Alloying Elements and Heat-Treatment. III—Pack Carburising. IV—Pack Carburising Practice. V—Gas Carburising. VI—Gas Carburising. VII—Nitriding. G. T. Colegate. *Metal Treatment*, Vol. 18, Nos. 64, 65, 66, 67, 69, 70, 71, January, February, March, April, June, July, August, 1951, pp. 5–12; 63–70; 103–110; 163–170; 249–256; 317–322; 363–368, illus. 53 references.

The Homogenisation of Steel Castings and Its Influence on the Mechanical Properties. I, II. British Iron and Steel Research Association, Steel Castings Division. *Metal Treatment*, Vol. 18, Nos. 67, 68, April, May, 1951, pp. 145–154; 195–200, illus.

Isothermal Transformation Diagrams for Nickel Steels. I—General Discussion of Diagrams. The Mond Nickel Company. *Metallurgia*, Vol. 43, No. 259, May, 1951, pp. 234–242, illus. 27 references.

Chi Phase in Alloy Steels; Its Relationship to Sigma Phase. K. W. Andrews and P. E. Brookes. *Metal Treatment*, Vol. 18, No. 70, July, 1951, pp. 301–311, illus. 24 references.

Plastic Stress-Strain Relations for 75S-T6 Aluminum Alloy Subjected to Biaxial Tensile Stresses. Joseph Marin, B. H. Ulrich, and W. P. Hughes. *U.S., N.A.C.A., Technical Note No. 2425*, August, 1951. 48 pp., illus. 3 references.

A New Medium-Strength Wrought Light Alloy of the Aluminium-Zinc-Magnesium Family—T.35. J. F. G. Hérenguel. *Metal Treatment*, Vol. 18, No. 64, pp. 33–36, illus. 8 references. Summary of an investigation of Al-Zn-Mg alloys in France; fabrication and properties of T.35.

A Versatile Aluminium-Copper-Silicon Alloy. A. P. Penn. *Metal Treatment*, Vol. 18, No. 69, June, 1951, pp. 246–248, illus. Composition and properties of D.T.D. 424 alloy; effects of heat-treatment on the mechanical properties; stabilizing treatment.

ML Aluminum Alloy—A Material for Elevated Temperatures. J. C. McGee. *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest*, Vol. 16, No. 8, August, 1951, pp. 6, 7, illus. Development, properties, melting practice and casting, creep and stress-rupture characteristics; comparison with Y alloy (142) aluminum.

New Aluminum Casting Alloy for Higher Temperatures. *Automotive Industries*, Vol. 105, No. 5, September 1, 1951, pp. 58, 90. Development, mechanical properties, and characteristics of ML aluminum alloy for uses at temperatures between 500° and 600° F.

The Heat Treatment of Aluminium Alloys. J. Crowther. *Metallurgia*, Vol. 43, No. 259, May, 1951, pp. 243–247, illus. Precipitation hardening; effect of alloy composition, solution treatment, annealing, and industrial heat-treatment.

Intermetallic Compounds in Ternary Aluminium-Rich Alloys Containing Transitional Metals. J. N. Pratt and G. V. Raynor. *Royal Society (London), Proceedings, Series A, Mathematical and Physical Sciences*, Vol. 205, No. 1808, January 22, 1951, pp. 103–118, illus. 14 references. Investigation of the composition of ternary aluminum-rich alloys containing transitional metal solutes, using alloys of Al-Mn-Si, Al-Fe-Si, Al-Cr-Si, and Al-Co-Si.

How Titanium Behaves at Temperatures Up to 900°F. W. L. Williams. (*Iron Age*, Vol. 167, No. 24, June 14, 1951, pp. 81–84.) *Engineers' Digest*, Vol. 12, No. 8, August, 1951, pp. 253, 254, illus. 3 references.

Electrolytic Polishing and Oxidation of Titanium. Pierre A. Jacquet. *Metal Treatment*, Vol. 18, No. 67, April, 1951, pp. 176, 182, illus. 3 references.

Zirconium Production, Properties, and Alloys. G. L. Miller. *Metallurgia*, Vol. 43, No. 259, May, 1951, pp. 209–214, 220, illus. 9 references. The Iodide and Kroll processes for extracting Zr from its ores; tabulation of properties and alloys.

NONMETALLIC MATERIALS

The Development of Synthetic Resin Adhesives for Improved Wood. I—Aniline-Formaldehyde Resins in Phenolic Adhesives. II—Cast Phenolic Adhesives. L. K. Dalton, J. S. Fitzgerald, G. W. Tack, and N. Tamblyn. *Australian Journal of Applied Science*, Vol. 2, No. 1, March, 1951, pp. 145–174, illus. 5 references.

Plastic Flow of Aniline-Formaldehyde Resins. L. K. Dalton. *Australian Journal of Applied Science*, Vol. 2, No. 1, March, 1951, pp. 132–144, illus. 13 references.

Glass Reinforced Plastics. Ivor Yassin. *Aero Digest*, Vol. 63, No. 2, August, 1951, pp. 44–46, 48, 50, illus. Properties and structural characteristics; uses; dies.

Effect of Stress-Solvent Crazing on Tensile Strength of Polymethyl Methacrylate. B. M. Axilrod and Martha A. Sherman. *U.S., N.A.C.A., Technical Note No. 2444*, August, 1951. 19 pp., illus. 2 references.

Tests results and analysis of the loss of strength of both heat-resistant and ordinary grades of commercial cast polymethylmethacrylate sheets (Lucite and Plexiglas) as a result of stress-solvent crazing.

FOR EVERY AVIATION REQUIREMENT

MILITARY...
COMMERCIAL...
CIVILIAN AIRCRAFT...
ROCKETS...
GUIDED MISSILES..
AIRBORNE OR GROUND EQUIPMENT

IT'S GEAR DRIVES BY WESTERN GEAR

ENGINEERS
are invited to send for copies of Aircraft Actuator Bulletin #4811 or Aircraft Equipment Bulletin #4801, or both.

5116

WESTERN GEAR WORKS
Manufacturers of PACIFIC-WESTERN Gear Products
Pacific Gear & Tool Works

Plants: Seattle
San Francisco
Lynwood
(Los Angeles County)
Houston
Representatives
Portland
Denver
Vancouver, B.C.

Plants • 3200 E. Imperial Highway, Lynwood, Los Angeles County, California
1035 Folsom St., San Francisco 3, Calif.
117 N. Palmer St., Houston, Texas
Representatives • 930 S. E. Oak St., Portland 14, Oregon
Room 211, Chamber of Commerce Bldg., Denver, Colorado
Engineering & Machinery Ltd., 1386 W. Broadway, Vancouver, B. C.

PROTECTIVE COATINGS

Hot Spraying of Lacquer Feasible for Aircraft. E. D. Mitchell and O. J. Winkles. *Automotive Industries*, Vol. 105, No. 5, September 1, 1951, pp. 42, 43, 106, illus. Studies on the hot spray application of lacquer to aircraft at Douglas Aircraft Co.; advantages of hot spray over cold spray.

Easier Way To Fight Salt Spray. Scott H. Reiniger. *Aviation Week*, Vol. 55, No. 8, August 20, 1951, pp. 37, 38, 43, 44, illus. Application process, users, performance, and data on the properties of Alodine, a chemical that forms a tough, nonmetallic surface on Al alloys.

The Protection of Metallic Surfaces by Chromium Diffusion. I—Survey of the Chromising Process. R. L. Samuel and N. A. Lockington. *Metal Treatment*, Vol. 18, No. 71, August, 1951, pp. 354–359, illus. 13 references.

Electroplating Aluminium and Aluminium Alloy Components. I—Study of Pretreatments and Dipping Processes. II—Electrolytes for Various Processes. E. E. Halls. *Metal Treatment*, Vol. 18, Nos. 66, 67, March, April, 1951, pp. 125–131; 177–182, illus.

SANDWICH MATERIALS

Optimum Distribution of Material in Sandwich Plates Loaded in Their Plane; Including Plates with Varying Modulus of Elasticity. P. P. Bijlaard. *Cornell Aeronautical Laboratory, Inc., Report No. SA-247-S-8*, March 15, 1950. 53 pp., illus. 3 references.

Theoretical derivations and calculation of results for the optimum design of proper sandwich plates, of plates with a continuous distribution of material, of plates consisting of five layers with three different constant elastic moduli, and of built-up sandwich plates.

Meteorology (30)

The Meteorological Teleprinter Service. P. Wüsthoff. *Interavia*, Vol. 6, No. 4, April, 1951, pp. 211, 212, illus. Western European weather teleprinter network.

Method for Measuring the Size of Water Droplets in Clouds, Fogs, and Sprays. N. Golitzine. (*Canada, National Research Council, Division of Mechanical Engineering, Engine Testing Laboratory, Report No. ME-177*, March 22, 1950.) *Canada, National Aeronautical Establishment, Ottawa, Note No. 6*, 1951. 35 pp., illus. 9 references.

On the Equations of Stationary Motion. T. Sato. *Papers in Meteorology and Geophysics*, Vol. 2, No. 1, March, 1951, pp. 52–57. 3 references. Analysis of the motion of frictional fluid moving under the influence of deflecting force on the rotating earth.

Notes on the Influence of Motion on the Temperature Lapse Rate and on the Stability of Dry and Moist Air. M. Takeuchi. *Papers in Meteorology and Geophysics*, Vol. 2, No. 1, March, 1951, pp. 58–64, illus. 6 references.

Non-Dimensional Equations and Modeling Criteria for the Atmosphere. Dave Fultz. *Journal of Meteorology*, Vol. 8, No. 4, August 1951, pp. 262–267. 16 references.

A Case Study of Confluence As Related to the Jet Stream. Philip F. Clapp and Jay S. Winston. *Journal of Meteorology*, Vol. 8, No. 4, August, 1951, pp. 231–243, illus. 14 references.

Detailed study of the characteristics of a well-developed case of confluence and the related changes in the jet stream; review and further development of the confluence theory as the explanation for the growth and decay of a jet stream.

Ionospheric Wind Systems and Electron Concentrations of the *F* Layer. Donald G. Yerg. *Journal of Meteorology*, Vol. 8, No. 4, August, 1951, pp. 244–250, illus. 8 references. Development of a meridional circulation for ionospheric regions; study of possible wind systems and their variation in the ionosphere.

Wind- and Gust-Measuring Instruments Developed for a Wind-Power Survey. H. H. Rosenbrock and J. R. Tagg. (*I.E.E., Measurements Section, Paper No. 1065.*) *Institution of Electrical Engineers, Proceedings, Part II, Power Engineering*, Vol. 98, No. 64, August, 1951, pp. 438–447, Discussion, pp. 456–460, illus. 6 references.

An Automatic Frost-Point Hygrometer for Measurements in the Upper Air. A. W. Brewer and R. H. Dobson. (*I.E.E., Measurements Section, Paper No. 1104.*) *Institution of Electrical Engineers, Part II, Power Engineering*, Vol. 98, No. 64, August, 1951, pp. 470–473, Discussion, pp. 480–484, illus. 2 references.

Design, components, and performance of an automatic hygrometer that continuously records over a range of frost points from +20°C. to −80°C., a humidity range from 100 to $^1/_4$ per cent, with an accuracy of ±1°C.

The Radar-Sonde System for the Measurement of Upper Wind and Air Data. F. E. Jones, J. E. N. Hooper, and N. L. Alder. (*I.E.E., Measurements Section, Paper No. 1095.*) *Institution of Electrical Engineers, Proceedings, Part II, Power Engineering*, Vol. 98, No. 64, August, 1951, pp. 461–469, Discussion, pp. 480–484, illus. 10 references. Brief review of the principles of radar-sonde systems; analysis of a system that employs secondary-radar principles; ground equipment.

Mean-Wind-Velocity Instruments for Use on Naval Craft. J. Bell and E. M. Langham. (*I.E.E., Measurements Section, Paper No. 1103.*) *Institution of Electrical Engineers, Proceedings, Part II, Power Engineering*, Vol. 98, No. 64, August, 1951, pp. 448–452, Discussion, pp. 456–460, illus. 5 references.

An instrument for aircraft carriers which indicates mean wind direction for proper orientation of the flight deck and which uses Magslip transmission elements and electric computing devices.

An Instrument Employing a Coronal Discharge for the Determination of Droplet-Size Distribution in Clouds. Rinaldo J. Brun, Joseph Levine, and Kenneth S. Kleinknecht. *U.S., N.A.C.A., Technical Note No. 2458*, September, 1951. 53 pp., illus. 13 references.

Navigation (29)

Simplified Flight Planning. W. G. Hamer. *Institute of Navigation, Journal*, Vol. 4, No. 3, July, 1951, pp. 248–259, illus.

The flight plan has the track divided into zones of 200 nautical miles rather than into zones based on longitude, simplifying the calculations for the flight. A Dalton E6B computer is used to calculate the flight time for each 200-mile zone.

The American Plan for Air Traffic Control; a Description of SC31. D. O. Fraser. *Institute of Navigation, Journal*, Vol. 4, No. 3, July, 1951, pp. 213–231, Discussion, pp. 232–236, illus. 5 references. The Radio Technical Commission for Aeronautics Common System of air navigation.

Very High Frequency Omni-Directional Range Navigation. Richard Watson Thwing. *Interavia*, Vol. 6, No. 4, April, 1951, pp. 213–217, illus. Air-borne VOR equipment and its technical operation; maximum, minimum, and intermediate standard VOR instrumentation systems.

The Learmatic Navigator. William P. Lear. *Aviation Age*, Vol. 16, No. 2, August, 1951, pp. 25–27, illus. The Learmatic Navigator combines a magnetic compass, a radio-compass pointer, and course-selector grid lines. Drawings show use of Navigator for various flight procedures.

Prevention of Echo Interference in Double-Pulse Coded Interrogator-Responder Systems. R. S. Styles. *Australian Journal of Applied Science*, Vol. 2, No. 1, March, 1951, pp. 26–42 illus. 8 references.

The Calibration of Aircraft Direction Finders With Particular Reference to Site Selection. J. H. Moon. *Marconi Review*, No. 103, 3rd Quarter, 1951, pp. 101–112, illus. 1 reference.

Determination of the sources of unusual irregular errors met in the calibration of air-borne direction finders. Errors were traced to the presence of steel reinforcements in runways, metal hangars, buried cables, and such.

Stand-By Compass; Details of the Ultra-Small E2A Instrument Made by Kelvin and Hughes. *Flight*, Vol. 60, No. 2221, August 17, 1951, p. 194, illus., cutaway drawings.

An Inductor Compass. A. Hine. (*I.E.E., Measurements Section, Paper No. 1099.*) *Institution of Electrical Engineers, Proceedings, Part II, Power Engineering*, Vol. 98, No. 64, August, 1951, pp. 485–495, Discussion, pp. 495–498, illus. 17 references.

In the inductor compass, the strength of two or more local components of the earth's magnetic field is measured; the strength is interpreted in terms of direction, and the information transmitted. For recording with a pointer or a light dial, a Desynn or Synchro type of transmitter is used; if plotting of the results is desired, a step-by-step M-type transmission can be used. The stabilization of the inductor type of compass is explained.

What's doing at JACK & HEINTZ

Special Products Developed for Systems Application

3 DEVICES INDICATE CONTROL POSSIBILITIES

An impressive array of products developed by Jack & Heintz engineers for special application in aircraft electrical systems, is now sharing the spotlight with J & H's widely used starters, motors, generators, actuators and inverters. Much of the success and acceptance of J & H Systems can be traced to the important role each accessory-device plays.

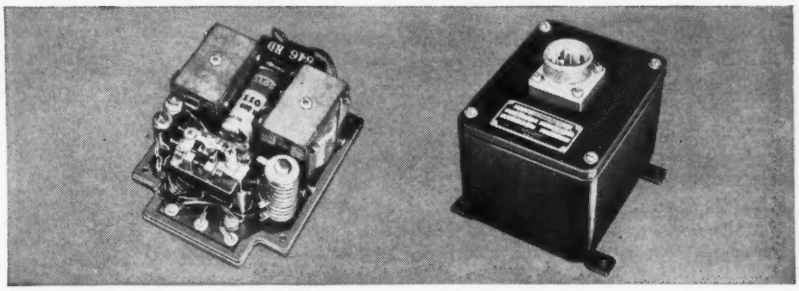
Typical of these devices is the new GC20 Frequency Sensitive Relay which offers protection from the effects of low frequency to equipment such as automatic pilots, gyros, computers and radar using 400-cycle power, as well as the source supplying that power. A frequency drop, occuring in an idling, grounded aircraft may cause extensive damage to this equipment.

The GC20 will remove power from the equipment, relieve load on the 350/400-cycle source, when frequency drops below limits, and will put load back only when frequency increases to the set pickup of the relay. It can be furnished to operate on either 120 or 208 volts, or as a single interchangeable unit that can be used on either voltage. It closes contacts at a given frequency and opens them at another lower frequency. Pickup and drop-out frequencies can be adjusted as close as 3 and as far as 20 cycles apart.

Another new device, the GC50 Overvoltage Protection Relay, protects a 120/208-volt, 3-phase, 400-cycle alternator. When overvoltage occurs, the relay closes its contacts and energizes the 24-volt, d-c coils of an exciter field relay and an alternator circuit breaker.

The GC57 Phase Sequence Relay, another new device, is used on a 120/208-volt, 3-phase, a-c system, operating through a frequency range from 100 to 1000 cycles per second. It consists of a 3-phase sensing motor, and a contact mechanism coupled together by the magnetic drag or eddy-current principle. The phase sequence sensing mechanism includes both fixed and movable contacts, the latter operated by a magnetic drag disc.

The fixed contacts form part of a single-pole, double-throw switch, one contact providing an out-of-phase indication, the other the normal-in-phase condition. The movable contact engages the fixed contacts and closes a circuit when in either extreme position. In a nonoperating condition, the movable contact is held in a center-off position. The introduction of a reversed-phase power source shifts the movable contact against the fixed indicating contact. If desired, it lights a warning indicator in the operating compartment. When the reversed-phase power is removed, the sensing device again assumes the normal "off" condition.

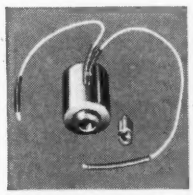


GC20 Frequency Sensitive Relay GC50 Overvoltage Protection Relay

Chief Engineer's Corner

Our J&H Engineering Department is organized to design and develop special aviation products you may need. And our Engineering Lab is equipped to build prototypes of these devices in a minimum of time, and to test them, under all environmental conditions to your specifications. Here, we develop special materials and build apparatus to meet specifications we could not hope to meet with materials available from other sources.

Typical, is our new J&H 28000 Solenoid, custom-built for use with a turbojet-engine accessory. This solenoid had to operate in an ambient temperature of 500° F. However, available insulating varnishes had a top limit of only 300° F.

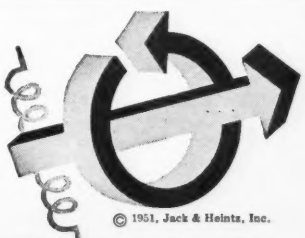


J&H 28000 Solenoid

To maintain compactness, J & H developed a special impregnating varnish. This solenoid, utilizing the new varnish, actually operates at 600° F.

If you have any special aircraft products in mind, please submit your requirements, including all available environmental and application data. Our engineers will be glad to work with you. Write JACK & HEINTZ, INC., Cleveland 1, Ohio.

JACK & HEINTZ *Rotomotive* EQUIPMENT



© 1951, Jack & Heintz, Inc.

means electrical, hydraulic or mechanical devices designed to solve unusual problems of developing power, controlling it, or using it.

The Construction of Hyperbolic Lattices. D. H. Sadler. *Institute of Navigation, Journal*, Vol. 4, No. 3, July, 1951, pp. 237–247, illus. 8 references. General principles and mechanism of the grid method of constructing hyperbolic lattices and related tables.

Ordnance & Armament (22)

The Measurement of Gun Muzzle Blast Pressures on a High-Speed Fighter Airplane. John E. Goldberg. *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest*, Vol. 16, No. 8, August, 1951, pp. 16–20, illus.

In-flight experimental investigation of muzzle-blast phenomena on a F-80B airplane; test equipment and procedure. Results show the orders of magnitude of muzzle-blast pressures and characteristics of the pressure wave as a function of flight speed and altitude. A compact pressure-type pickup was designed for the tests; the output was fed through a three-stage preamplifier to a cathode-ray oscillograph.

Parachutes

Method of Estimating the Minimum Size of a Tail or Wing-Tip Parachute for Emergency Spin Recovery of an Airplane. Frank S. Malvestuto, Jr. *U.S., N.A.C.A., Research Memorandum No. L8D27*, October 27, 1948. 42 pp., illus. 8 references.

Photography (26)

On Kerr Cell Construction. W. R. Smythe. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, p. 1087, illus. 1 reference. Construction details that provide a solution of the inhomogeneous field problem in Kerr cells.

Power Plants

British Power. *Aeronautics*, Vol. 25, No. 2, September, 1951, pp. 63–67, diagrs. Specifications of British reciprocating and gas-turbine engines, as exhibited at the S.B.A.C. display at Farnborough.

JET & TURBINE (5)

Analysis of Thrust Augmentation of Turbojet Engines by Water Injection at Compressor Inlet, Including Charts for Calculating Compression Processes with Water Injection. E. Clinton Wilcox and Arthur M. Trout. *U.S., N.A.C.A., Report No. 1006*, 1951. 20 pp., illus. 8 references. Superintendent of Documents, Washington. $0.25.

G-E's "Advanced J47." Paul H. Wilkinson. *Aviation Age*, Vol. 16, No. 2, August, 1951, pp. 30, 31, illus.

Stratos To Produce French Baby Turbine. George L. Christian. *Aviation Week*, Vol. 55, No. 9, August, 1951, pp. 51, 52, 54, 57, cutaway drawing. Specifications of the Turboméca Oredon, a 140-shaft-horsepower gas turbine, which will be built under license by Stratos Division, Fairchild Engine and Airplane Corp.

Stress Analysis at Height; Stain-Gauging of Turbine-Blades During Flight (by Rolls-Royce, Ltd.) *Flight*, Vol. 60, No. 2219, August 3, 1951, p. 146, illus.

RECIPROCATING (6)

Chemical Effects in Internal Combustion Engines. J. J. Broeze. (*Polytechnisch Tijdschrift*, Vol. 6, No. 25–26, June 26, 1951, pp. 427a–441a.) *Engineers' Digest*, Vol. 12, No. 8, August, 1951, pp. 255–257, 264, illus. 3 references. The chemistry of the combustion process.

A Biharmonic Relaxation Method for Calculating Thermal Stress in Cooled Irregular Cylinders. Arthur G. Holms. *U.S., N.A.C.A., Technical Note No. 2434*, August, 1951. 49 pp. illus. 13 references.

Plug Fouling Remedies Discussed; European Ignition Conference Studies TCP Compound and Other Means. Nathaniel McKitterick. *Aviation Week*, Vol. 55, No. 7, August 13, 1951, pp. 57–59, 62.

ROCKET (4)

Measurement of Velocity and Pressure of Gases in Rocket Flames by Spectroscopic Methods. F. P. Bundy, H. M. Strong, and A. B. Gregg. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1069–1077, illus. 2 references.

A method for measuring the exhaust velocity directly by observing the doppler shift of wave length of the Na or Li line spectrum radiation emitted from the flame at different angles; apparatus and instrumentation; experimental data; accuracy.

Mobile Recording System for Rocket-Motor Tests. Kenneth C. Sutherland and William H. Spalding. *California Institute of Technology, Jet Propulsion Laboratory, Memorandum No. 4-61*, December 4, 1950. 10 pp., illus. 1 reference.

Flow of Gases in Porous Media. L. H. Wilson, W. L. Sibbitt, and M. Jakob. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1027–1030, illus. 7 references. Theoretical review of viscous and free molecular flow phenomena as part of a study of the sweat-cooling application with porous media in rocket work.

Production (36)

Small-Batch Production; The Use of Production Methods in the Jobbing Shop. R. B. Wilkinson. *Aircraft Production*, Vol. 13, No. 155, September, 1951, pp. 293, 294.

A Fully Demountable Twin-Hull Assembly Buck for Seaplanes. R. E. Bechtol. *Automotive Industries*, Vol. 105, No. 4, August 15, 1951, pp. 46, 47, illus. Demountable indoor assembly buck permits simultaneous, side-by-side construction of two hulls for the Convair R3Y-1 turboprop flying boats.

Stock-Handling; Pratt and Whitney Book System for the Storage of Sheet Metal. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 260, 261, illus.

Designing and Pattern Dies for Investment Casting. II. Rawson L. Wood and Davidlee Von Ludwig. *Tool Engineer*, Vol. 27, No. 3, September, 1951, pp. 42–44, illus.

Economic advantages; multiple-cavity dies; drafting requirements; accuracy and shrinkages. The variables that affect calculation of pattern die dimensions are tabulated.

Materials & Methods Manual No. 73: Die Castings. T. C. Du Mond. *Materials & Methods*, Vol. 34, No. 2, August, 1951, pp. 83–98, illus. Methods of production, materials, comparisons of die castings with other fabricated forms, important design principles, finishing, and applications.

Centrifugal Forming. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 245, 246, illus.

A centrifugal method of shaping sheet thermoplastic material uses no forming dies. Developed by Goodyear Aircraft Corp., the method consists of fastening the edge of the heated sheet relative to the axis of rotation, in a plane perpendicular to the axis of rotation, and rotating the sheet at a speed sufficient to form the sheet by centrifugal force.

Modern Diesinking Practice. E. W. Peel. *Metal Treatment*, Vol. 18, No. 66, March, 1951, pp. 95–101, illus. Die design and machining; the diesinking process; milling machines for copying or duplicating from a master die.

Advanced Methods for Machining Jet Engine Parts. *Automotive Industries*, Vol. 105, No. 4, August 15, 1951, pp. 38–40, 67, 68, 72, 94, illus. New tooling methods and machines used by Pratt & Whitney Aircraft.

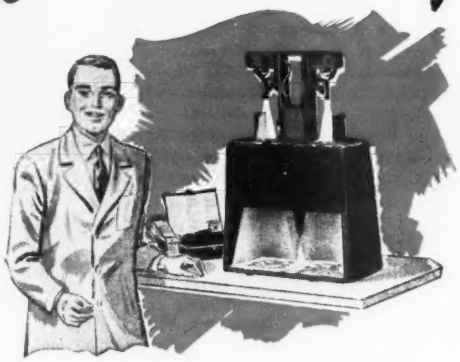
Contour Milling; Requirements of the United States Aircraft Industry; Survey and Proposals. *Aircraft Production*, Vol. 13, No. 155, September, 1951, pp. 290–293, illus. 3 references.

Wing-Folding Mechanism. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 242–244, illus.

Machining intricate and heavy-duty components on the Vickers-Supermarine Attacker naval fighter. All parts are machined from S.65 forgings or black bar stock. The machining sequences are listed and explained for the claw-attachment, ball-fitting, claw, and jack-slide components. An acceptance gage is used to check the alignment of the assembly, position of the spar-attachment holes, and the travel of the jack-slide fitting.

Structural Light-Alloy Riveting with the High-Tensile Alloys. J. G. Whitman. *The Engineer*, Vol. 192, No. 2987, August 24, 1951, pp. 228–231, illus. Development work in light-alloy riveting; types of rivets under consideration; the cold-squeeze riveting process.

Announcing...THE NEW BRUSH FAXFILM®

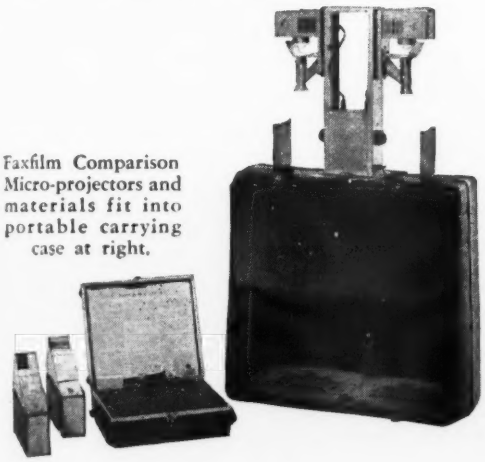


AN AMAZING TOOL FOR FAST STUDY AND COMPARISON OF SURFACES

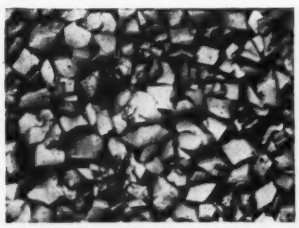
● In less than a minute you can make a reverse replica of practically any surface on Faxfilm. Then, after mounting the film and placing it in the Faxfilm projector, you can study and compare surfaces at magnifications of 30 or 100 times.

The Faxfilm projection shows roughness, wear, grain, texture, and finish of the test surface in minute detail. You can check flats, curves, cones, bores, and irregular shapes of metals, textiles, ceramics, fibers, tissues and other materials.

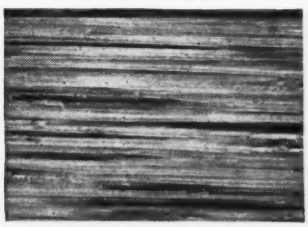
If quick information about surfaces is important to you, write for complete information now on Faxfilm. The Brush Development Co., Cleveland 14, Ohio, U.S.A. *Canadian Representatives:* A. C. Wickman (Canada) Limited, P. O. Box 9, Station N, Toronto 14, Ontario.



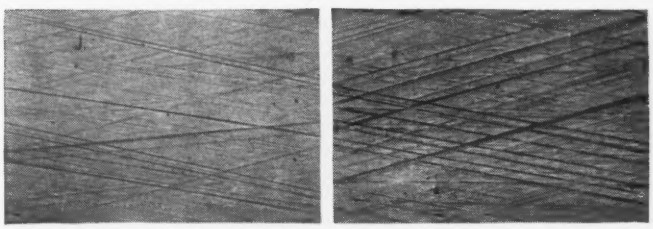
Faxfilm Comparison Micro-projectors and materials fit into portable carrying case at right.



Faxfilm projection of cylinder bore treated with Lubrite indicates uniformity of crystal size and complete coverage.

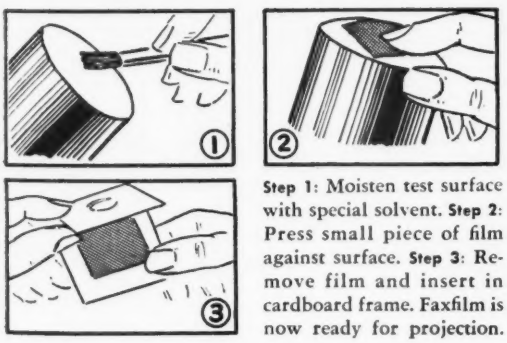


Faxfilm of steel surface with ground finish. Faxfilm is excellent for checking best speeds, feeds, and lubrication for machining.



Comparison of honed finishes in which difference in roughness is only 3 microinches RMS. (6 MU. RMS at left; 9 MU. RMS at right.)

ONE MINUTE TO MAKE A TEST!



Step 1: Moisten test surface with special solvent. **Step 2:** Press small piece of film against surface. **Step 3:** Remove film and insert in cardboard frame. Faxfilm is now ready for projection.

WRITE FOR COMPLETE INFORMATION

THE *Brush* DEVELOPMENT COMPANY

PIEZOELECTRIC CRYSTALS & CERAMICS • MAGNETIC RECORDING • ELECTROACOUSTICS • ULTRASONICS • INDUSTRIAL & RESEARCH INSTRUMENTS

THE BRUSH DEVELOPMENT COMPANY, Dept. S-16
3405 Perkins Avenue, Cleveland 14, Ohio

Please send complete data on uses of Faxfilm. I would like this for: (please check)

☐ reference ☐ immediate planning

Your Name .....

Company .....

Address .....

City ..... *State* .....

Resistance Welding of Aluminum Steels and Coated Metal Improved by Slope Control. F. L. Miller. *Materials & Methods*, Vol. 34, No. 2, August, 1951, pp. 80–82, illus.

Engineering for Producibility; How To Organize and Design for Lowest Cost. Roger W. Bolz. *Machine Design*, Vol. 23, No. 8, August, 1951, pp. 133–156, illus. 14 references.

Turbine-Blade Inspection. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 249, 250, illus. Improved system of the Société Genevoise AP-14 projector illuminates, by six lamps, a wide band of the blade. The image is projected on a screen.

Planning and Production Methods Used in the Construction of the de Havilland Comet. H. Povey. *de Havilland Gazette*, No. 64, Supplement, August, 1951, pp. 3–33, Discussion, pp. 33–39, illus. *Royal Aeronautical Society, Journal*, Vol. 55, No. 488, August, 1951, pp. 459–514, Discussion, pp. 515–517, illus.

America Tools for Expansion. *Aircraft Production*, Vol. 13, No. 154, August, 1951, pp. 254–257, illus. Hufford extrusion and sheet-forming machines, the Taylor-Winfield flash-butt welder, and the Mesta 18,000-ton vertical press.

Gas-Turbine Tooling. *Aircraft Production*, Vol. 13, No. 155, September, 1951, pp. 264–267, illus.

New tooling methods and machine tools at Pratt & Whitney Aircraft include a tee-bed lathe for maching thin-walled stainless-steel rings of large diameter for nozzle-vane rings, blade shrouds, and tailpipes; a three-head drilling maching that can drill, ram, and countersink at one setup of the part; a 15-ton 90-in. vertical broaching machine; an improved lathe-grinder and turret lathe.

Standard-Unit Tooling. *Aircraft Production*, Vol. 13, No. 155, September, 1951, pp. 288, 289, illus. 1 reference. Jig and fixture assembly from standard parts, based on the Purefoy unit tooling-system.

Tailored Tools Speed Ryan Engine Work. *Aviation Week*, Vol. 55, No. 10, September 3, 1951, pp. 33–35, illus.

Tool Flexibility Raises Jet Engine Output; P & W A Meets Medium Production Rate Needs with New Machines. *Aviation Week*, Vol. 55, No. 7, August 13, 1951, pp. 21, 22, 25, 26, 28, illus.

Propellers (11)

Steel Airscrew Blades; The de Havilland Composite Construction. II—Forming Operations on the Shell; Blade-Assembly and Brazing. III—Rubber-Filling and Final Operations. *Aircraft Production*, Vol. 13, Nos. 154, 155, August, September, 1951, pp. 234–240; 268–275, illus.

The Efficiency of Airscrews on Wings of Large Chord. E. Ower and R. Warden. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2438*, 1951 (March 16, 1939). 18 pp., illus. 6 references. British Information Services, New York. $1.25.

The Effects of Reynolds Number on the Application of NACA 16-Series Airfoil Characteristics to Propeller Design. Harold E. Cleary. *U.S., N.A.C.A., Research Memorandum No. L7H12*, October 6, 1947. 15 pp., illus. 3 references.

Reference Works (47)

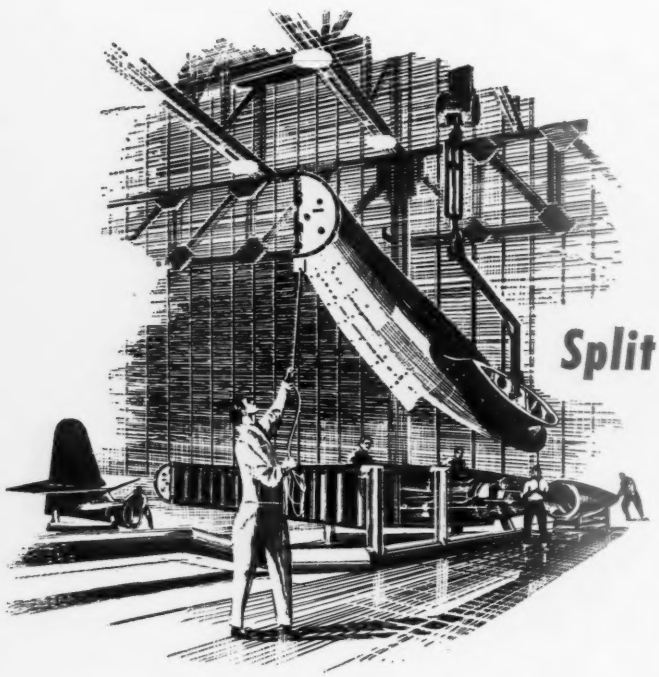
BIBLIOGRAPHIES

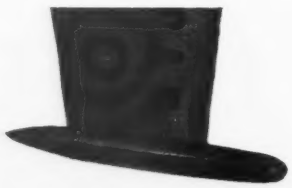
A Survey of the Literature Pertaining to Stress Distribution in the Vicinity of a Hole and the Design of Pressure Vessels. Mervin B. Hogan. *Utah, University, Bulletin (Engineering Experiment Station, Bulletin No. 48)*, Vol. 41, No. 2, August, 1950. 93 pp., illus. 533 references.

Summary of the analytic aspects of the problem; bibliography of 527 references to U.S. and foreign reports and periodicals on stress distribution due to holes and notches and on the design of pressure vessels, cylinders, and spherical shells; author index to the bibliography.

DICTIONARIES

English-French Vocabulary of Aeronautical Terms; Based on British Standard 185: 1950, Glossary of Aeronautical Terms. V. M. Chalmette. *Aircraft Engineering*, Vol. 23, No. 270, August, 1951, pp. 239, 240.





To speed delivery, Northrop builds Scorpions by longitudinal halves, right up to final assembly. This "on-the-half-shell" production technique permits free installation of equipment in wings, fuselage, tail, and nose.

Split Scorpions Hatch Faster!

Manufacturing ingenuity at Northrop results in consistent high production marks. The Scorpion F-89, newest Air Force all-weather interceptor, is fast and deadly—with electronic search equipment and heavy armament. It is a modern successor to the famous P-61 Black Widows, built by the hundreds at Northrop during World War II.

Northrop
Pioneer

Rotating Wing Aircraft (34)

The Baynes Heliplane of 1937/39. L. E. Baynes. *The Aeroplane*, Vol. 81, No. 2092, August 24, 1951, pp. 216–218, illus.

Some Present and Future Aspects of Helicopter Piloting. II. J. S. Fay. *American Helicopter*, Vol. 23, No. 8, July, 1951, pp. 8–11, 18, illus. Types of emergency landings and piloting techniques for handling them; standards for design of controls to minimize pilot fatigue.

Some Lessons of the Liverpool-Cardiff Helicopter Passenger Service. III—Traffic Handling and Turn-Round Technique. L. S. Wigdortchik. *American Helicopter*, Vol. 23, No. 8, July, 1951, pp. 14–17, 19, 20, illus.

Experimental Helicopter Blades Put Through Tests in Wire "Cages." *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest*, Vol. 16, No. 9, September, 1951, p. 7, illus.

Helicopter-rotor test tower and a 12-ft. test stand are each surrounded by a chain link fence that serves as protection if a rotor blade should disintegrate. The test facilities can handle rotors up to 90 ft. in diameter; the test tower measures lift up to 40,000 lbs., the test stand measures lift up to 12,000 lbs.

Sciences, General (33)

MATHEMATICS

An Electronic Digital Computer. I. R. C. M. Barnes, E. H. Cooke-Yarborough, and D. G. A. Thomas. *Electronic Engineering*, Vol. 23, No. 282, August, 1951, pp. 286–291, illus. 11 references.

An Introduction to Computer Concepts. II. John D. Goodell. *Radio & Television News*, Vol. 46, No. 3, September, 1951, *Radio-Electronic Engineering*, pp. 7–9, illus. Applications of digital and analog computing systems; design considerations.

MADDIDA Digital Differential Analyzer. *Northrop Aircraft, Inc., Brochure No. 38*, December, 1950. 19 pp., illus.

General description of MADDIDA 44A and of the principles of its operation including an explanation of the differential analyzer principle, working of a digital differential analyzer, computation speed, general layout of the components, and a sample scaling setup.

The Solution of Boundary Value Problems by Multiple Laplace Transformations. Thelma A. Estrin and Thomas James Higgins. *Franklin Institute, Journal*, Vol. 252, No. 2, August, 1951, pp. 153–167, illus. 9 references.

Development of a theory for the solution of boundary-value problems by multiple Laplace transformations; solution of problems in electrostatics and in heat conduction using the theory.

The One-Sided Green's Function. Kenneth S. Miller. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1054–1057, 4 references.

Presentation of the one-sided Green's Function for use in problems (particularly in network theory) having one-point boundary conditions, the solution of which is required over more than a finite interval.

Some Roots of an Equation Involving Bessel Functions. B. P. Bogert. *Journal of Mathematics and Physics*, Vol. 30, No. 2, July, 1951, pp. 102–105, tables. 7 references.

Time-Dependent Heaviside Operators. Lotfi A. Zadeh. *Journal of Mathematics and Physics*, Vol. 30, No. 2, July, 1951, pp. 73–78. 8 references.

Time and Frequency Uncertainty in Waveform Analysis. P. M. Woodward. *Philosophical Magazine*, Vol. 42 (7th Series), No. 331, August, 1951, pp. 883–891, illus. 2 references.

The concept of a structural time-constant is introduced by considering the time autocorrelation function of any waveform, and a structural frequency-constant is similarly defined in terms of the spectral autocorrelation function. An absolute structural constant, invariant for all waveforms, is shown to be

$$c = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} |\chi|^2 d\tau d\phi$$

free your draftsmen from tedious lettering jobs...

Vari-Type Lettering

BILLS OF MATERIAL, SPECIFICATIONS, NOTES ETC...ALL EXPERTLY LETTERED BY YOUR TYPIST..... ON A VARI-TYPER LETTERING MACHINE.

THE VARI-TYPER LETTERING MACHINE OFFERS THE FASTEST METHOD OF LETTERING BILLS OF MATERIAL, NOTES, SPECIFICATIONS ON TRACINGS AND DRAWINGS, AND COUNTLESS OTHER LETTERING DETAILS NOW BOTTLE-NECKING THE DRAFTING ROOM OUTPUT. THE VARI-TYPER LETTERING MACHINE IS FOUR TO FIVE TIMES FASTER THAN HAND LETTERING AND IS OPERATED BY AN OFFICE TYPIST.

SAVE YOUR DRAFTSMEN'S TIME FOR MORE IMPORTANT CREATIVE DRAFTING WORK.

TYPE FACES ARE INSTANTLY AND EASILY INTERCHANGEABLE OFFERING HUNDREDS OF DIFFERENT SIZES AND STYLES FROM WHICH TO CHOOSE.

Letters any size tracing _ even 6 feet or more.

RALPH C. COXHEAD CORP.
720 Frelinghuysen Avenue, Newark 5, N. J.

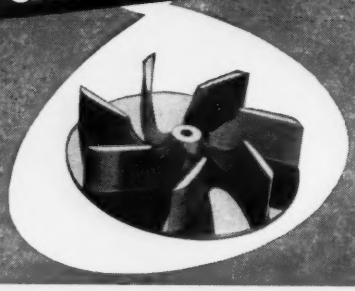
Please send me Vari-typer Booklet No. A26

Name .....
Company .....
Address .....
City ..... Zone....State.....

Alcoa makes ALUMINUM DIE CASTINGS

Large die-casting facilities, 63 years of aluminum experience and a staff of "old hands" at die casting aluminum make Alcoa a dependable source of supply for quality die castings. For details, see your local Alcoa specialist. He's listed under "aluminum" in your classified phone book. Or write: ALUMINUM COMPANY OF AMERICA, 1913 M Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA *Aluminum* DIE CASTINGS



DESIGNERS AVAILABLE

"CAL-AERO TECH" graduates are immediately useful without break-in...and dependable.

EXPERIENCE

4000 hours on board and in aircraft shops, with fundamentals and actual work assignments under supervision of Aircraft Factory Experienced Designers — specializing in design of component parts — proficient in layout, strength checking and manufacturing process analysis.

***New class graduates each month*— serving Douglas • North American • Boeing • Northrop • Curtiss-Wright • Lockheed Convair • Ryan • Airesearch • and many others.**

HIRE A "CAL-AERO" GRADUATE — HE'LL DELIVER THE GOODS

Phone or write
CAL-AERO TECHNICAL INSTITUTE
Grand Central Air Terminal — Glendale 1, California

Aircraft Engineering

FOUNDED 1929

The Technical and Scientific Aeronautical Monthly

Edited by Lt.-Col. W. Lockwood Marsh
F.I.Ae.S., M.S.A.E., F.R.Ae.S.

Single Copies: 35 cents, post free
Subscription: $5.00 per annum, post free

BUNHILL PUBLICATIONS LIMITED
12 Bloomsbury Square London : : W.C.1 England

The complex Gaussian pulse and the real Gaussian pulse-train illustrate the analysis.

PHYSICS

The Effect of Motion on the Acoustic Radiation of a Sound Source. Hans L. Oestreicher. *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest*, Vol. 16, No. 9, September, 1951, pp. 16–19, illus. 2 references. Derivation of a general formula for the field of a sound source of zero and the first order moving arbitrarily at subsonic velocities.

The Relation Between Vortex Noise and Wing Resistance. W. W. von Wittern. *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest*, Vol. 16, No. 9, September, 1951, pp. 20–23, illus. 5 references.

Analysis of sound measurements of the vortex sound generation of rods of different profiles rotating like propeller blades at tip speeds up to $M = 1.0$ to determine the relation between the generated vortex sound and the wind resistance.

Space Travel

Fundamental Dynamics of Reaction-Powered Space Vehicles. L. N. Thompson. (*Institution of Mechanical Engineers, Preprint*, 1951.) *Aircraft Engineering*, Vol. 23, No. 270, August, 1951, pp. 228–234, illus. 6 references.

Structures (7)

Readers' Forum: The Effect of Compressibility of the Material on Plastic Buckling Stresses. Elbridge Z. Stowell and Richard A. Pride. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, p. 773, illus. 2 references. Evaluation of the error caused by neglecting the compressibility effects.

On Creep and Relaxation. III. B. Gross and H. Pelzer. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1035–1039, illus. 8 references. Generalization of the theory of linear reversible creep to include plastic deformations and permanent set.

A Critical Review of Notch Sensitivity in Stress-Rupture Tests. W. F. Brown, Jr., and George Sachs. *U.S., N.A.C.A., Technical Note No. 2433*, August, 1951. 29 pp., illus. 17 references. Critical review and correlation of experimental data obtained from the English and German literature on notch stress-rupture testing.

A Photoelastic Investigation of Stress Concentrations Due to Small Fillets and Grooves in Tension. M. M. Frocht. *U.S., N.A.C.A., Technical Note No. 2442*, August, 1951. 45 pp., illus. 3 references.

Shear Center for Thin-Walled Open Sections Beyond the Elastic Limit. G. H. Handelman. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 749–754, 766, illus. 6 references.

Determination of the location of the shear center, assuming that only the axial stress and the shear stress are acting on the beam; formulas for channel and nonsymmetric sections.

The Axis of Distortion of a Twisted Elastic Prism. D. G. Ashwell. *Philosophical Magazine*, Vol. 42 (7th Series), No. 331, August, 1951, pp. 820–832, illus. 2 references.

Analysis of the distortion of a twisted elastic cantilever, without reference to its support. The distinction between the axes of twist and the distortion is explained by showing the effect of each on practical cantilevers.

A Survey of the Literature Pertaining to Stress Distribution in the Vicinity of a Hole and the Design of Pressure Vessels. Mervin B. Hogan. *Utah, University, Bulletin (Engineering Experiment Station, Bulletin No. 48)*, Vol. 41, No. 2, August, 1950. 93 pp., illus. 533 references.

Summary of the analytic aspects of the problem; bibliography of 527 references to U.S. and foreign reports and periodicals on stress distribution due to holes and notches and on the design of pressure vessels, cylinders, and spherical shells; author index to the bibliography.

Elastic Energy of an Ellipsoidal Inclusion in an Infinite Solid. Kenneth Robinson. *Journal of Applied Physics*, Vol. 22, No. 8, August, 1951, pp. 1045–1054, illus. 11 references.

An exact solution in closed form for the displacements, stresses, and total elastic energy for the problem of an ellipsoidal isotropic inclusion bonded to an isotropic body of infinite extent when the inclusion and the infinite solid have uniformly distributed changes in their stress-free specific volumes.

On the State of Stress in a Plastic-Rigid Body at the Yield Point. R. Hill. *Philosophical Magazine*, Vol. 42 (7th Series), No. 331, August, 1951, pp. 868–875, illus. 6 references. Analysis of the practical significance of the yield-point load for an actual elastic-plastic body; review of U.S. work on the plastic-limit design of structures.

A Theoretical Investigation of the Compression of a Ductile Material Between Smooth Flat Dies. A. P. Green. *Philosophical Magazine*, Vol. 42 (7th Series), No. 331, August, 1951, pp. 900–918, illus. 17 references.

Analysis of the stress and velocity distribution during the indentation of a strip on opposite sides using two smooth flat dies whose width is greater than the thickness of the test specimen, by the theory of plane plastic strain and the slip-line field of Hencky and Geiringer.

A Comparison Between Plain and Stringer-Reinforced Sheet from the Shear Lag Standpoint. M. Fine. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2648*, 1951 (October, 1941). 5 pp., illus. 3 references. British Information Services, New York. $0.40.

Some Results of Sweptback Wing Structural Studies. A. L. Lang and R. L. Bisplinghoff. *Journal of the Aeronautical Sciences*, Vol. 18, No. 11, November, 1951, pp. 705–717, illus. 10 references.

Static stress and deflection tests on a 45° sweptback single-cell beam; comparison of results with simplified theories for predicting stresses and deformations in swept shell beams.

Thermodynamics (18)

Calculating Air Pressure Drop of Heat Exchangers. Richard E. Shafer. *Machine Design*, Vol. 23, No. 8, August, 1951, p. 124, illus.

Presentation of a method for calculating the air-pressure drop in a compact, lightweight, low air-pressure drop, air-to-liquid heat exchanger. The method neglects the effect of tubing fins; accuracy is ±5 per cent of the experimental value.

An Investigation of Aircraft Heaters. XXXIV—Experimental Determination of Thermal and Hydrodynamical Behavior of Air Flowing Between a Flat and a Wave-Shaped Plate. L. M. K. Boelter, V. D. Sanders, G. Young, M. Morgan, and E. H. Morrin. *U.S., N.A.C.A., Technical Note No. 2426*, August, 1951. 30 pp., illus. 3 references.

An Investigation of Aircraft Heaters. XXXVI—Preliminary Investigation of a Combustion-Type Aircraft Heater. L. M. K. Boelter, W. R. Elswick, V. D. Sanders, and M. W. Rubesin. *U.S., N.A.C.A., Technical Note No. 2428*, August, 1951. 15 pp., illus. 2 references.

Preheated gas and combustion tests on a 50,000-B.t.u. per hour combustion type heater with parallel and centerflow passages of a type used for cabin-heating and anti-icing systems.

The Cool Flame of Methyl Ethyl Ketone. J. Bardwell and Cyril Hinshelwood. *Royal Society (London), Proceedings, Series A, Mathematical and Physical Sciences*, Vol. 205, No. 1082, February 22, 1951, pp. 375–390, illus. 21 references.

Determination of the regions of temperature and composition for which slow reaction, explosion, single, and multiple cool flames occur in the system of gaseous butanone-oxygen. The results are related to the general theory of hydrocarbon combustion, and the various phenomena are interpreted in terms of the view that the cool flame represents not the combustion of the primary reactants but the explosive decomposition of small quantities of accumulated intermediate peroxides.

Combustion of Smoke in Diffusion and Bunsen Flames. Thomas P. Clark. *U.S., N.A.C.A., Research Memorandum No. E51E15*, August 13, 1951. 13 pp., illus.

Laboratory study of the combustion of smoke in diffusion and bunsen flames of ethylene to determine if smoke from an outside source could be burned in the reaction zone.

Combustion of Hydrocarbon Mists. C. B. Davies. *Shell Aviation News*, No. 157, July, 1951, pp. 15–17. Explosion hazards caused by the formation of atomized mist or sprays in crankcases and gear boxes of internal combustion engines; influence of flame speed; ignition temperature.

Analytical Method for Determining Performance of Turbojet-Engine Tail-Pipe Heat Exchangers. Michael Behun and Harri-

Over 85% of the torque wrenches used in industry are

STURTEVANT TORQUE WRENCHES

Read by Sight, Sound or Feel

- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

in inch ounces
...inch pounds
...foot pounds
(All sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

P.A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

FIRST TO PASS AIR MATERIEL COMMAND TESTS

At Wright Field! For USAF Spec. 12047-A

INSULITE XLT-175

Vinyl Electrical Insulating Tubing

USAF Spec. 12047-A requires polyvinyl electrical insulating tubing with

★ Complete Resistance to Corrosion
★ Excellent Low Temperature Characteristics
★ High Dielectric Strength
★ Will Not Grow Fungus or Support Fungus Growth

Write for Air Force inspected test reports today.

Extruders INC. AIRCRAFT PRODUCTS DIVISION 3232 W. EL SEGUNDO BLVD. HAWTHORNE, CALIF.

DISTRIBUTORS AND AGENTS

SOUTHWEST
Air Accessories, Inc.
Dallas—Fort Worth
Texas

MIDWEST
L. A. Anderson
2061 W. Market St.
Akron 13, Ohio

EAST
Harry Bittan and
Ben Joseph
551 Fifth Avenue
New York 17, New York

AIRCRAFT APPROVED

V5 Solenoid STAINLESS STEEL Valves

THREE-WAY NORMALLY OPEN AND NORMALLY CLOSED

WEIGHT ONLY 1¼ LBS. APPROX. 3½" HIGH

Soft synthetic rubber inserts in plunger prevent leakage...Spring loaded for positive action...Power consumption approx. 10 watts...Usable in any position...Operating pressure to 150 P.S.I....Fluid connections to suit your specifications.

Some models for aircraft, such as valve illustrated, have Yellow Dot approval. Other solenoid aircraft valves available and under development for pressures to 3,000 P.S.I.

Two-way normally open and normally closed solenoid valves for special media such as liquid oxygen, nitric acid and concentrated hydrogen peroxide are also available in a variety of sizes.

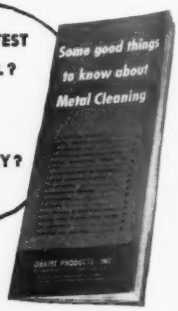
Inquiries regarding your solenoid valve problems are welcomed.

SKINNER ELECTRIC VALVES

Skinner ELECTRIC VALVE DIV.
THE SKINNER CHUCK COMPANY
143 Belden Ave., Norwalk, Conn.

WHAT'S THE FASTEST WAY TO CLEAN METAL? See page 11

WHAT'S THE MOST ECONOMICAL WAY? See page 9



Oakite's New FREE Booklet

"Some good things to know about Metal Cleaning"

answers many questions that mean better production, more profit for you. Just look at the table of contents:

- Tank cleaning methods
- Machine cleaning methods
- Electrocleaning steel
- Electrocleaning nonferrous metals
- Pickling, deoxidizing, bright dipping
- Pre-paint treatment in machines, in tanks and by hand
- Paint-stripping
- Steam-detergent cleaning
- Barrel cleaning
- Burnishing
- Better cleaning in hard-water areas
- Treating water in paint spray booths
- Rust prevention
- Machining and grinding

FREE For this 44-page illustrated booklet, write Oakite Products, Inc., 27 Thames St., New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

son C. Chandler, Jr. *U.S., N.A.C.A., Technical Note No. 2456,* September, 1951. 42 pp., illus. 7 references.

Study of the performance of parallel-flow type of tailpipe heat exchangers on a turbojet engine without an afterburner. Generalized working charts are developed for the performance of unfinned heat exchangers at outlet air temperatures of 700° and 1,100°R.

Heat Delivery in a Compressible Flow and Applications to Hot-Wire Anemometry. Chan-Mou Tchen. *U.S., N.A.C.A., Technical Note No. 2436,* August, 1951. 63 pp., illus. 6 references.

Development of the generalized potential theory for a flow with rotation and variable heat energy; analysis of the distributions of heat energy and heat flux, the amount of heat delivery, and the perturbations of the flow by heat. A straight array of heat sources, parallel to a stream of uniform velocity, was used for this study. Heat delivery at subsonic and supersonic speeds was calculated, including the effects of compressibility and nonlinear cooling in the results. Applications to hot-wire anemometry for velocity measurement are considered.

Water-Borne Aircraft (21)

Hydrodynamic Characteristics of a Low-Drag, Planing-Tail Flying-Boat Hull. Henry B. Suydam. *U.S., N.A.C.A., Research Memorandum No. L7I10,* October 21, 1948. 22 pp., illus. 6 references.

Aerodynamic Characteristics of a Refined Deep-Step Planing-Tail Flying-Boat Hull with Various Forebody and Afterbody Shapes. John M. Riebe and Rodger L. Naeseth. *U.S., N.A.C.A., Research Memorandum No. L8F01,* November 5, 1948. 61 pp., illus. 2 references.

Aerodynamic Characteristics of Three Deep-Step Planing-Tail Flying Boat Hulls. John M. Riebe and Rodger L. Naeseth. *U.S., N.A.C.A., Research Memorandum No. L8I27,* October 22, 1948. 27 pp., illus. 5 references.

Wind Tunnels & Research Facilities

Research at Langley Field. Research with High-Speed Models. *The Aeroplane,* Vol. 81, Nos. 2090, 2091, August, 10, 17, 1951, pp. 154–157; 190–192, illus. Test facilities and equipment and research programs at N.A.C.A.'s Langley Aeronautical Laboratory and the Pilotless Aircraft Research Station at Wallops Island, Va.

Supersonic Rocket Missiles Tested at Secret Station. Robert McLarren. *Automotive Industries,* Vol. 105, No. 5, September 1, 1951, pp. 34–37, 100, illus. N.A.C.A.'s Wallops Island (Va.) Pilotless Aircraft Research Station.

Current Projects in Aerodynamics Laboratory, Aircraft and Allied Instrument Laboratory, Engine Laboratory, Flight Research Section, Fuels and Lubricants Laboratory, Gas Dynamics Section, Hydraulics Laboratory, Low Temperature Laboratory, and Structures Laboratory. *Canada, National Research Council, Aeronautical Laboratories, Quarterly Bulletin, Report No. ME 1951* (2), April 1–June 30, 1951, pp. 7–25, illus.

Wilderness Lab Serves Avro. *Aviation Week,* Vol. 55, No. 9, August 27, 1951, pp. 33, 34, illus. Facilities and equipment of Avro Canada's jet-engine test center at Nobel, Ont.

The Nobel Gas Turbine Test Establishment. *Aircraft,* Vol. 13, No. 9, September, 1951, pp. 9, 10, illus.

Facilities, equipment, and scope of operation at Avro Canada's Test Establishment at Nobel, Ont. Compressor, turbine, and combustion-chamber tests are being carried out on the Orenda.

Jet Secrets Probed at Nobel Test Plant. *Canadian Aviation,* Vol. 24, No. 9, pp. 26, 27, 83, illus.

Facilities, equipment, and scope of operations at Avro Canada's Test Establishment at Nobel, Ont., for compressor, turbine, and combustion-chamber studies of gas-turbine engines. Principle testing devices are a variable-incidence cascade wind tunnel, a diffuser test rig, and a combustion rig.

Just Name the Weather—Fort Belvoir Lab Technicians Will Produce It. *U.S., Central Air Documents Office (Army-Navy-Air Force), Technical Data Digest,* Vol. 16, No. 8, August, 1951, pp. 9, 10, illus.

Equipment and facilities of the Climatic Research and Test Laboratory. A temperature range from −65° to 165°F. can be obtained in six hours; a pressure equal to an altitude of 35,000 ft. can be obtained in ½ hour; humidity can be varied from 20 to 100 per cent.

New Load-Absorbing Test Lab. *Aviation Age,* Vol. 16, No. 2, August, 1951, p. 37, illus. Construction details of a new engineering static test laboratory building at Douglas Aircraft Co., Inc.

Out of Their Systems. *Boeing Magazine,* Vol. 21, No. 8, August, 1951, pp. 10–13, illus. Facilities for studying the effects of temperature and altitude on equipment and the hydraulic testing setup in Boeing's Mechanical Engineering Laboratory.

Aircooled Jet Engine Muffler. *Aviation Age,* Vol. 16, No. 2, August, 1951, p. 36, illus.

Noise-suppression muffler built by Northrop Aircraft, Inc., will lessen noise from the afterburners on the twin-jet F-89. The aircooled muffler is 95 ft. long, 10 to 16 ft. wide, and 6 to 12 ft. high. Sound-absorbing louvres will be placed in front of the jet intakes.

Condensation Phenomena in Supersonic Tunnels. Leonard M. Majesks. *Aero Digest,* Vol. 63, No. 2, August, 1951, pp. 19, 56–59, 66, 68, 70, illus. 7 references. Explanation of condensation and installations to prevent it. A detailed analysis is presented for the preparation, use, and advantages of silica gel as a desiccating agent.

Air Condensation in Hypersonic Flow. P. Wegener, S. Reed, Jr., E. Stollenwerk, and G. Lundquist. *Journal of Applied Physics,* Vol. 22, No. 8, August, 1951, pp. 1077–1083, illus. 14 references. Condensation studies in the N.O.L. 12- by 12-cm. hyperballistics tunnel; analysis of the thermodynamics of the condensation problem.

Optical Methods Involving Light Scattering for Measuring Size and Concentration of Condensation Particles in Supercooled Hypersonic Flow. Enoch J. Durbin. *U.S., N.A.C.A., Technical Note No. 2441,* August, 1951. 28 pp., illus. 7 references. Experimental evaluation of two methods based on scattered-light measurements and on transmitted-light measurements; review of the theory of light scattering.

Pitot-Tube Readings Near Shock Waves in the N.P.L. and R.A.E. High Speed Tunnels. R. G. Fowler. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2468,* 1951 (February 2, 1945). 13 pp., illus. 7 references. British information Services, New York. $0.75. Analysis of test results to determine the reasons for loss of pitot pressure and the effects of condensation on pitot readings.

Calibration of the Royal Aircraft Establishment 24-Ft. Wind Tunnel. J. E. Allen and K. V. Diprose. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2566,* 1951 (June, 1942). 16 pp., illus. 1 reference. British Information Services, New York. $0.90.

Calculation of the Interference on a Thin Symmetrical Aerofoil with Hinged Flap Spanning a Closed-Wind Tunnel. J. H. Preston and A. R. Manwell. *Gr. Brit., Aeronautical Research Council, Reports and Memoranda No. 2465,* 1951 (October 16, 1941). 14 pp., illus. 7 references. British Information Services, New York. $1.00.

Readers' Forum: Visualization of Boundary-Layer Flow. James S. Murphy and Ralph E. Phinney. *Journal of the Aeronautical Sciences,* Vol. 18, No. 11, November, 1951, pp. 771–772, illus. 6 references.

China-film technique for indicating streamline direction, position of shock reflection, and transition of boundary-layer flow. The method involves the suspension of China-clay particles in a bonding agent and a volatile liquid that is applied to the surface under study. As the volatile liquid evaporates during the test, the China-clay particles show the streamline pattern on the surface.

Shock Tubes for Hypersonic Flow. A. Hertzberg. *Cornell Aeronautical Laboratory, Inc., Report No. Af-702-A-1,* May, 1951. 12 pp., illus. 7 references. Creation of steady hypersonic flows in the region behind the normal shock; theoretical and experimental analysis, using a shock tube with design Mach Number of 4.2.

The Organization of Research. D. B. Harris. *Institute of Radio Engineers, Proceedings,* Vol. 39, No. 8, August, 1951, pp. 868–873.

Lockheed *P2V* Neptune
power packages built by

ROHR

World's largest producer
of ready-to-install
power packages
for airplanes

in Chula Vista, California. . 9 miles from San Diego

ROHR
AIRCRAFT CORPORATION

Aeronautical Reviews — BOOKS

Grenzschicht-Theorie

By Hermann Schlichting. Karlsruhe, Germany, Verlag und Druck G. Braun, 1951. 483 pp., figs. $10.50.

Since Prandtl's original exposition of the basic concepts of a boundary layer in 1904, few other branches of aerodynamics have been subjected to such exhaustive theoretical and experimental research. It has been more than 10 years since this field of work has been adequately summarized. In the meantime, many important contributions have been made to the literature. For example, the method of calculating the stability of a laminar boundary layer to small disturbances has been highly developed, and the basic theory has been checked experimentally during this period. Other important recent advances have been made in connection with the effects of compressibility on boundary-layer flow and the study of heat transfer.

Dr. Schlichting has performed a much needed service in summarizing the extensive literature in his book, *Boundary-Layer Theory*. The book is composed of four main divisions. The first gives the basic relations for the flow of a viscous compressible fluid; the second deals with laminar boundary layers; the third, with transition from laminar to turbulent boundary-layer flow; and the last, with turbulent boundary layers.

After two introductory chapters, Dr. Schlichting begins his formal development of the subject with a derivation of the Navier-Stokes equations which appeals strongly to the reader's physical intuition. Subsequent chapters in the first division discuss general properties and exact solutions of the Navier-Stokes equations, including consideration of "creeping" motion.

In addition to the topics conventionally discussed under the heading of laminar boundary layers, such subjects of current interest as boundary layers on swept wings, boundary-layer control to increase the extent of laminar flow, boundary layers with heat transfer, and boundary layers in compressible flow are treated.

The division of the book dealing with transition gives a detailed, careful, but relatively easily read account of the Tollmien-Schlichting theory of the amplification of small disturbances, together with the results of stability calculation for a number of cases. Unfortunately, the theory has not yet been sufficiently developed to determine how large a disturbance may be, compared with the boundary-layer thickness, and still be considered small.

The final division of the book, having to do with turbulent boundary layers, bases most of the discussion on the mixing-length concepts developed by Prandtl, von Kármán, G. I. Taylor, and others. In addition to the skin-friction and velocity-distribution relations for rough and smooth pipes and flat plates, Dr. Schlichting discusses the effects of pressure gradients on the development of two- and three-dimensional turbulent boundary layers. Little, however, is said about the theory of isotropic turbulence although reference is made to a few of the more basic papers on this subject.

The work as a whole represents an unusually thorough and basically sound treatment of the subject of boundary layers. Although the primary emphasis is on the theory, Dr. Schlichting has not hesitated to present experimental data wherever pertinent.

A feature particularly useful for the research worker is the large list of references given at the end of each chapter. In those cases where a topic is not fully treated in the text itself, adequate references to source material are generally given. It is to be hoped that this book, which bids fair to become a standard work on the subject, will be made available in English.

ALBERT E. VON DOENHOFF
Head, Low Turbulence Branch
N.A.C.A., Langley Air Force Base

Thermodynamics of Fluid Flow

By Newman A. Hall. New York, Prentice-Hall, Inc., 1951. 278 pp., figs. $7.35.

Since the combination of words used in the title of this book is a new one, a few remarks seem appropriate relative to the place in fluid mechanics which this book is intended to fill. Roughly, we might divide the study of the flow of incompressible fluids into two parts: hydraulics and hydrodynamics. Under the first is usually included the one-dimensional theory of fluid motion. When this one-dimensional treatment is supplemented by correlated empirical coefficients to account for the various viscous and eddy effects not includable in a one-dimensional theory, the subject of hydraulics becomes of immense value to the practicing engineer in the design of fluid systems. Hydrodynamics, on the other hand, attempts to use no empiric data beyond the fluid properties (density, viscosity, etc.) and to predict all subsequent flow effects.

In the treatment of the flow of compressible fluids, the general approach to one-, two-, and three-dimensional flow has been developed as gas dynamics with applications in large part to airplanes and missiles. In the present book, one-dimensional flow of an arbitrary compressible fluid in a constant- or varying-area passage with or without friction or heat transfer is derived. Since a general fluid is under consideration, thermodynamic properties of the substances concerned are a necessary part of the fluid mechanics of the system.

The book first discusses basic ideas and interrelations required for a one-dimensional description of fluid flow. Fluid friction is considered, and the empiric friction coefficients are introduced. The energy and continuity equations are derived. Finally, the momentum equation is derived. Considerably more than customary use is made of the entropy changes encountered in the flow processes. This increased emphasis on entropy effects is an important step forward in the consideration of the flow of compressible fluids. The relation between the general theory thus developed and flow of incompressible fluids (hydraulics) is first considered, and then the special form of the various equations appropriate to a perfect gas is derived. This accounts for approximately the first third of the book.

In the second third, there are considered in detail: adiabatic flow through a constant-area passage, adiabatic flow through a varying-area passage, compression shocks, the application of all these ideas to flow measurement and

For information on I.A.S. Library Service Facilities, see page 85

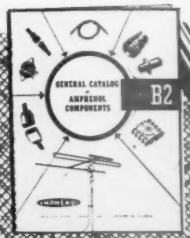
Statements and opinions expressed in Book Reviews are to be understood as individual expressions and not necessarily those of the Institute.

PREPAREDNESS PRODUCTION

Enlists

AMPHENOL

Every element of national preparedness — from the smallest rivet to the finished ship, plane or piece of equipment — requires the best design, materials and workmanship. For if the decisions of these turbulent historic moments must finally be made in the field rather than in the halls of the U.N., the material of preparedness must work and work well! Amphenol RF Cables, RF Connectors and A-N Connectors have long been recognized as the quality electronic components and therefore preparedness production enlists Amphenol!



NOW AVAILABLE —

Catalog B2 — A General Catalog of Amphenol Components — will be sent upon receipt of a request on company or government agency letterhead.

AMERICAN PHENOLIC CORPORATION

1830 South 54th Avenue Chicago 50, Illinois

control, diabatic flow (flow with heat transfer as in a heat exchange), and finally a discussion of propulsion systems which makes use of all of the previous material.

The last third of the book is taken up primarily by extensive tables that are needed for computing the flow of perfect gas through various kinds of processes as discussed earlier in the book.

The author's treatment of all this material is accurate and straightforward. However, material is occasionally presented in a form that would lead the student to feel that there were no basic problems left which had not been, for practical purposes, completely cleared up. This is particularly true in the derivations of the basic equations and the interrelations between them. This, of course, is not out of step with many of the texts on hydraulics and, in fact, was the approach used by almost all texts up to a relatively recent date when a more basic approach to fluid mechanics became useful.

In the reviewer's opinion, the book will serve as an excellent introduction to engineering system analyses, but the development of the subject would have been better served had open problems been brought out during the course of development.

HOWARD W. EMMONS
Gordon McKay Professor
of Engineering Science
Harvard University

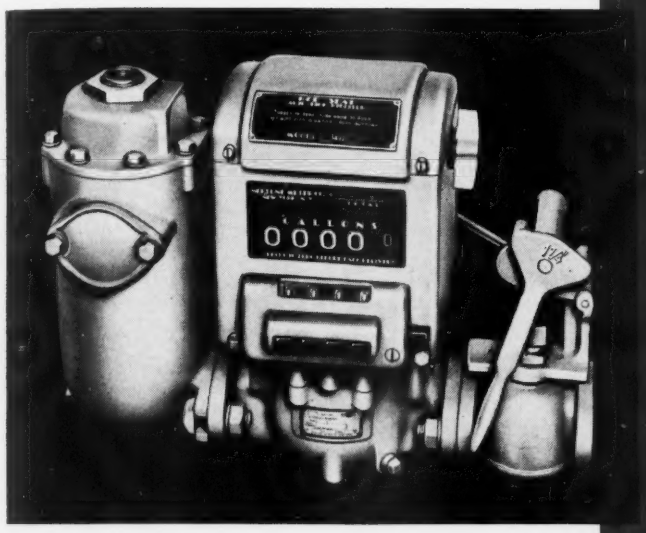
Problems of Cosmical Aerodynamics

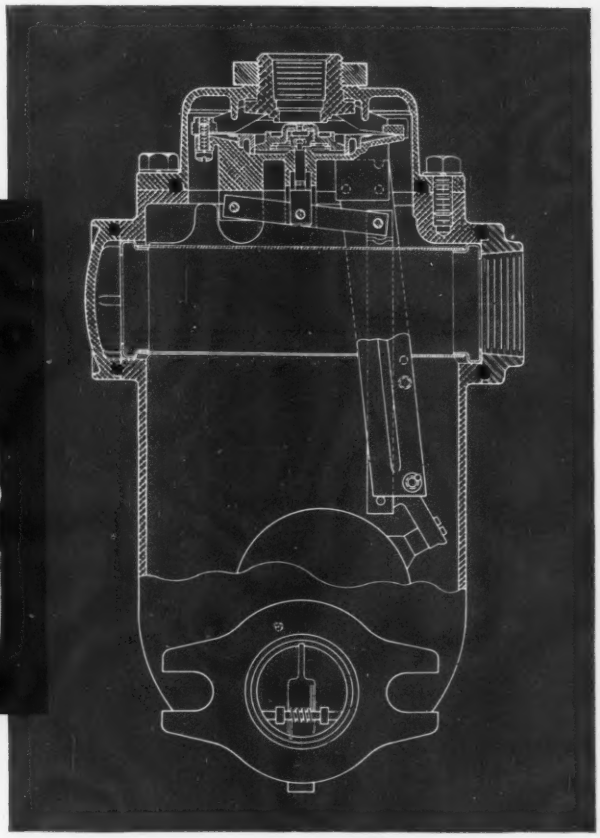
Proceedings of the Symposium on the Motion of Gaseous Masses of Cosmical Dimensions Held in Paris, August 16–19, 1949. International Union of Theoretical and Applied Mechanics and International Astronomical Union. Dayton 2, Ohio, U.B. Building, Central Air Documents Office (Army-Navy-Air Force), 1951. 237 pp., illus., diagrs.

This symposium was organized by the International Union of Theoretical and Applied Mechanics and the International Astronomical Union with the cooperation of the United Nations Educational, Scientific and Cultural Organization. Thirty-four astronomers and 18 aerodynamicists and physicists composed the symposium. In this connection it is interesting to note that the astronomers made a plea to the aerodynamicists for guidance on the problem of interstellar cloud formation.

The proceedings consist of 20 formal papers and 12 carefully documented discussions led by authorities in their respective fields. This type of symposium brings out the most advanced thinking since it offers the benefits of immediate response to questions raised.

In Chapter 35, J. M. Burgers presents a concise summary of the discussions of the symposium. He states that two groups of problems have been considered: high-velocity flow with expansion and compression, and turbulent motion. In the first group he refers to the paper of R. J. Seeger, "Physical





TIP...

FOR THE DESIGNER

Always Ready for Action With...

LINEAR "O" RINGS

The drying out of gaskets in meters stored for even short periods is a common trouble. It is costly, too!

The makers of Neptune Compact Meters for tank trucks licked this problem with Linear "O" Rings . . . eliminated the need for disassembling and re-assembling meters before they could be put into service. Exhaustive tests showed that no leaks occur even well beyond standard test pressures. And years of service *on the job* confirmed test results.

This is another example of what can be accomplished with Linear "O" Rings in advanced engineering and design. The substitution of Linear "O" Rings for conventional compression gaskets in Neptune Meters provided a perfect seal with *metal-to-metal* contact between flanges. This means an end to the need for periodic checking and tightening of bolts . . . less down-time and repair expenses due to gasket failure . . . simplified and much less expensive inspection procedures. Many a sealing problem becomes no problem at all when Linear "O" Rings replace conventional gaskets!

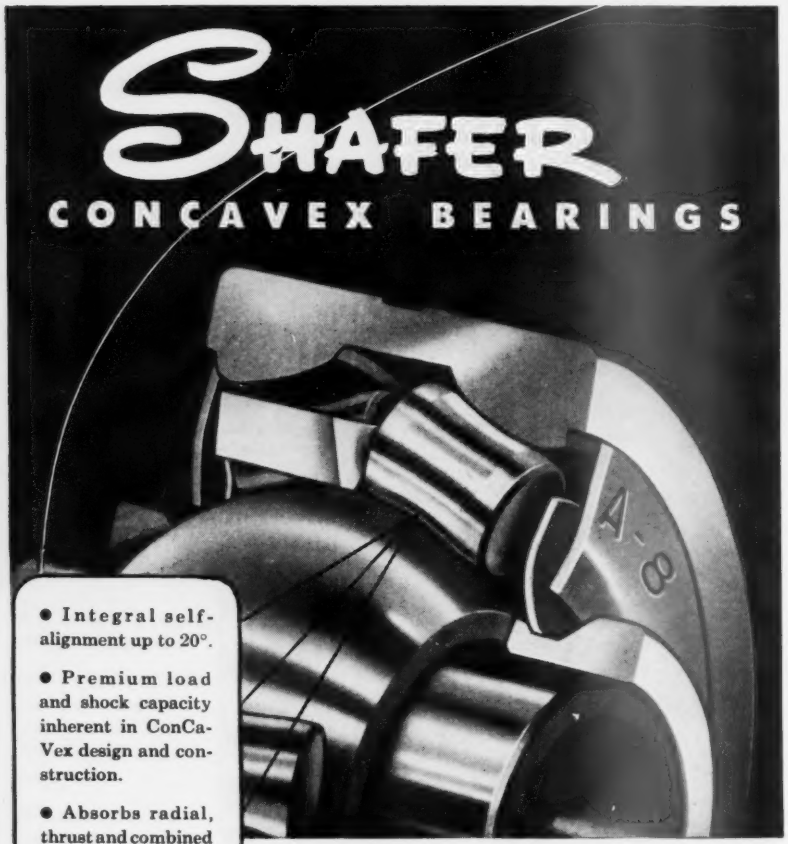
Linear "O" Rings are compounded of natural or synthetic rubber, fluorethylene polymers, and "Silastics" . . . are molded in a complete range of J.I.C. and A.N. standard sizes, as well as hundreds of non-standard sizes and special shapes. Precision molded under rigid laboratory control, Linear "O" Rings may be depended upon for continuous and lasting service.

It will pay you to consult Linear during the design stages of your sealing applications.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK STREET, PHILADELPHIA 35, PA.



- Integral self-alignment up to 20°.
- Premium load and shock capacity inherent in ConCa-Vex design and construction.
- Absorbs radial, thrust and combined loads.

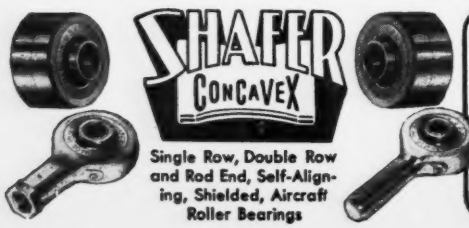
THE LIGHTWEIGHT
HEAVYWEIGHTS
FOR AIRCRAFT....

Shafer Bearings have long been waiting for aircraft demands to approach their ability for absorbing tremendous overloads and shocks. This explains the aircraft industry's steadily growing trend to "Shaferize" the vital control mechanisms of every type of air-borne craft—both commercial and military.

The basic ConCaVex design is an aircraft "natural." It provides high load and shock capacity, low friction and integral self-alignment together with space-saving, weight-saving compactness. This, combined with advanced engineering, precision craftsmanship and finest materials have, for 32 years, ranked Shafers as the No. 1 choice in aircraft control bearings.

Compare them. Test them. You'll find they surpass YOUR every expectation just as they surpass every rigid Army and Navy specification. Write for aircraft Bearing Catalog No. 50.

SHAFER BEARING CORPORATION
801 Burlington Ave. • Downers Grove, Illinois



Single Row, Double Row and Rod End, Self-Aligning, Shielded, Aircraft Roller Bearings

The best in Industrial Bearings, too! Write for new Catalog No. 51.

Problems of High-Altitude Flight," in which Seeger points out that velocities up to a Mach Number of 20 are attainable in firing ranges.

In the next order of velocities come the meteors, which move at such velocities that they are heated up to a temperature where evaporation takes place. F. Zwicky mentions meteors displaying periodic heating, a behavior that is similar to that of novae. At these high temperatures ionization takes place.

The problems of the motion of hot gases about the sun are discussed in the light of shock-wave theory by E. Schatzman, M. Minnaert, G. Temple, and J. M. Burgers.

The violent emission of shells of gaseous matter from stars, novae, was treated by Mrs. Cecilia Payne-Gaposchkin.

When the velocity of a gaseous mass becomes so high that extreme temperatures result from compressibility, ionization takes place, and, as is well known, motions of these gaseous clouds of charged particles take on the properties of a current. This current, in turn, induces magnetic fields. Such problems, which involve motions of gaseous masses under the influence of magnetic and electric fields, are indeed a new concept for the aerodynamicist.

On reading further in these Proceedings, one is impressed by the magnitude and complexity of cosmic aerodynamics. Zwicky gave a dimension of a cluster of nebulae as 7,000,000 or 8,000,000 light years. This is a scale far removed from the aerodynamics of aeronautical engineers. Even the scale in which dynamic meteoroiogists work is infinitely small compared to the size of a nebula. The symposium indicates to the classical aerodynamicist the similarity of turbulent flows and nebulae. Fortunately, the classical aerodynamicist is not yet troubled with magnetic and electric exchanges of energy, but he will derive some interesting knowledge from the astronomers. As a matter of fact, the interrelation of thermodynamics and aerodynamics, which began to receive emphasis only recently, may be better understood from an overall consideration of problems of astronomy.

For the aerodynamicist concerned with the flow of air even at the very low density of superaerodynamics, this publication would be of only academic interest. However, for the theoretical aerodynamicist who is interested in extending the realm of his mathematical tools, these Proceedings are excellent material. In fact, the symposium was organized with the hope that the discussions will at least formulate the approach to the many unknown problems of cosmic space. If nothing else, the aerodynamicist will gain a little more confidence in the theories that he has been applying when he reads that turbulence theory, as presented so elegantly by von Kármán in these Proceedings, is a tool that extends to light-year dimensions.

DR. AUGUST RASPET
Research Associate
Mississippi State College

Advances in Applied Mechanics, Volume II

Edited by Richard von Mises and Theodore von Kármán. New York, Academic Press, Inc., 1951. 233 pp., figs. $6.50.

The principal aim of the series, *Advances in Applied Mechanics*, is to give the mature reader a review and the status of the outstanding researches in many fields of applied mechanics. The papers are rarely interrelated, and each chapter is an entity. The second volume contains six papers and starts with an essay, "On the Statistical Theory of Isotropic Turbulence," by Th. von Kármán and C. C. Lin, where the authors examine the correlation and spectral theories and derive a simple physical picture that explains most of the experimental data gathered thus far. The paper ends with hopes that further research will be conducted to deepen our knowledge of these phenomena.

"The Laminar Boundary Layer in Compressible Flow" is the second paper and is interestingly and ably handled by G. Kuerti, who, by this contribution, proves that he is not only an excellent translator (*Mechanics of Deformable Bodies*, Sommerfeld) but a first-class author in his own right. His paper discusses the mechanical and thermodynamic interaction between a stream of gas at high speed and a rigid surface parallel to the stream. Numerical solutions for certain restricted problems given at the end of the paper facilitate the understanding of the physics of the problem.

"Bending of Curved Tubes" is discussed next by R. A. Clark and E. Reissner. This is a valuable and practical contribution since the theory and examples are directly applicable to stress problems encountered in airplanes and probably in other structures.

The next paper by P. F. Neményi, on "Recent Developments in Inverse and Semi-Inverse Methods in the Mechanics of Continua," deals with certain partial differential equations where the boundary conditions are not prescribed at the outset. The method described can be used in many branches of mechanics. Problems of elasticity and plasticity are mathematically treated, thus enlarging our knowledge of these particular fields.

The last, and to this reviewer a most exciting contribution, by P. Ya. Polubarinova-Kochina (masterfully translated by D. R. Mazkewich) is entitled, "Theory of Filtration of Liquids in Porous Media." This is a very thorough physico-mathematical treatise comprising 13 subchapters packed with useful information, and the mathematical treatment is clear and concise.

In general, Volume II of *Advances in Applied Mechanics* is equal in depth and presentation to Volume I, and the editors are to be congratulated for a fine selection of subjects and authors and for excellent editorial work.

STEPHEN J. ZAND
Vice-President
In Charge of Engineering
Lord Manufacturing Company

JET ENGINES DEAFENING ROAR
MADE WHISPER QUIET BY ISC

ISC Muffler installed at A. V. Roe Co., Malton, Ont., plant

ISC Jet Engine Mufflers reduce engine roar at A. V. Roe Company so effectively that AVRO reports: "It is now possible to converse in normal tones near an operating engine whereas we used to have to wear ear muffs for protection at such distances. Our engines under test now run so quietly that many employees and nearby residents don't realize they are running." This is but one more example of why aircraft manufacturers across the continent depend on ISC Mufflers and other "Soundmetal" installations to solve the problem of excessive noise, heat and gases generated during the ground testing of jet engines. Write for detailed information on how ISC can quiet your operation in the test cell or on the airstrip.

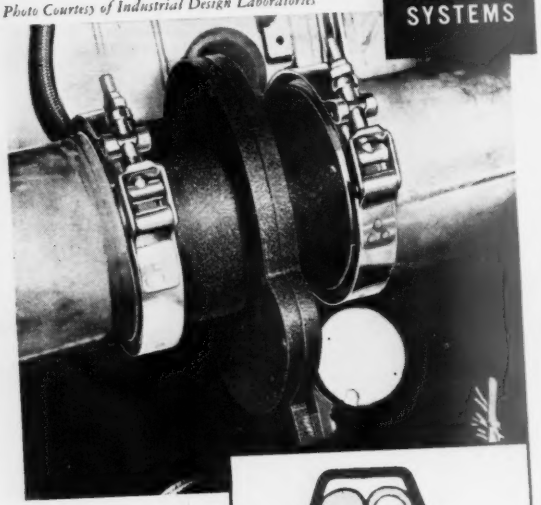
FOREIGN LICENSEES: Cementation (Muffelite) Limited, London
Les Travaux Souterrains, Paris

Industrial Sound Control, Inc.
45 GRANBY STREET HARTFORD, CONN.
2119 SO. SEPULVEDA BLVD. LOS ANGELES, CALIF.

ENGINEERS NOTEBOOK

HEATING SYSTEMS

Photo Courtesy of Industrial Design Laboratories



MARMAN

V-Bands and integral welded flanges simplify duct coupling on Globemaster

An ideal arrangement for coupling iris control valve in by-pass heating duct of the Douglas C-124 Globemaster II is achieved with a standard Marman V-Band Coupling and integral welded flanges. This is but one example of many diversified applications where standard Marman couplings and flanges provide the right combination of strength, light weight and positive seal, plus production and maintenance advantages of the patented "Quick Coupler Latch."

Save Cost, Time and Weight with Marman

FOR INFORMATION, WRITE DEPT. R-12

MARMAN PRODUCTS CO., Inc.
940 W. FLORENCE AVE.
INGLEWOOD, CALIFORNIA

STANDARD CLAMPS FOR SPECIAL APPLICATIONS

The Aircraft Industry, a Study in Industrial Location

By William Glenn Cunningham. Los Angeles 18, 1915 S. Western Ave., Calif., Lorrin L. Morrison, 1951. 263 pp., illus., maps. $6.00.

This book presents an interesting study of the aircraft manufacturing industry, with special reference to its development and to the influences affecting its constantly shifting areas of location over the past years and currently continuing under national defense requirements.

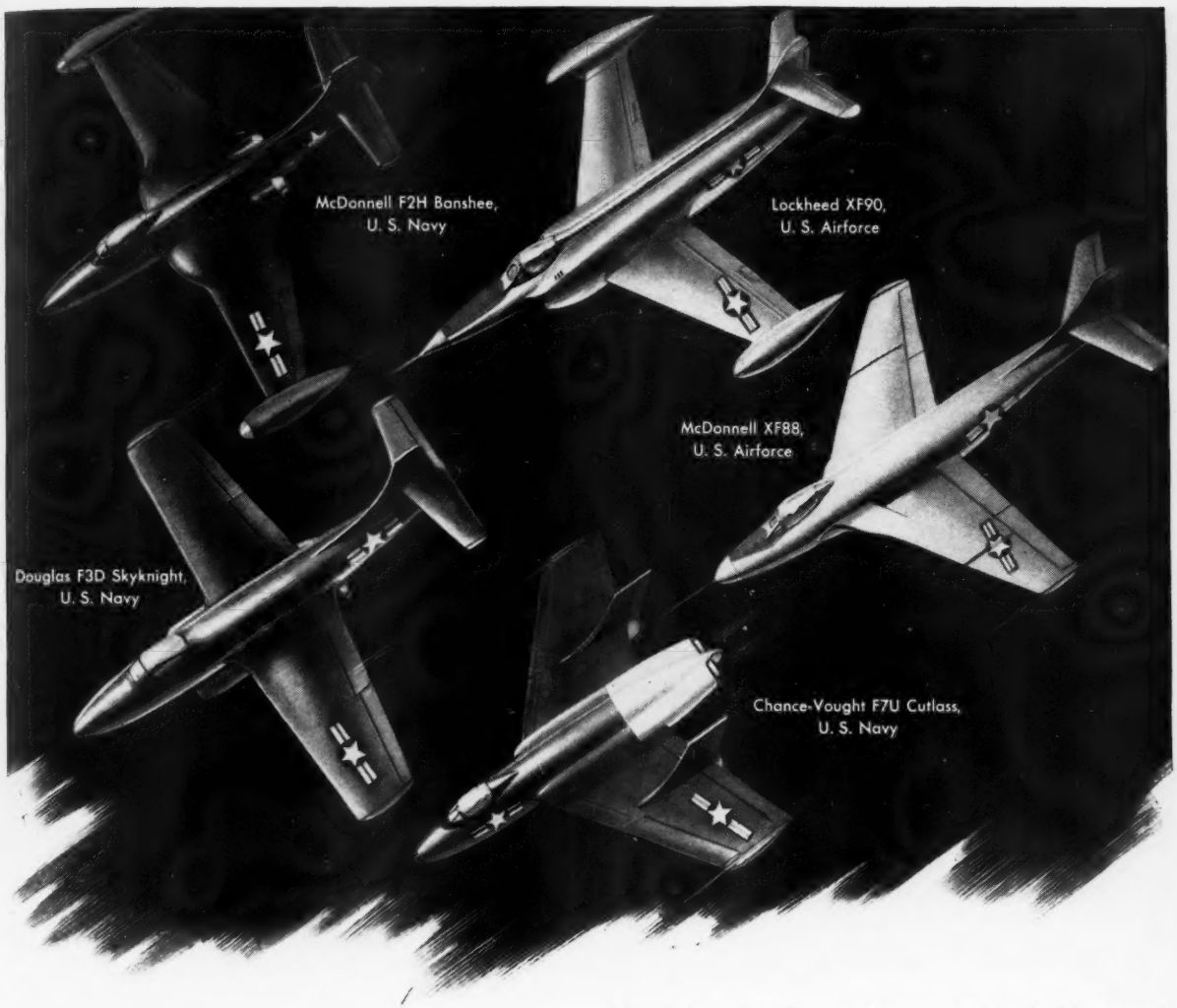
In clarification of the phase of aeronautics covered by this case study, the author describes the aeronautical industry as currently embracing all activities associated with the entire science of flight, with two divisions of manufacture. The aviation segment is composed of the manufacturers of airplane instruments and parts and the operators of flying services. The aircraft division is engaged in the manufacture or assembling of air frames, or aircraft engines and propellers and the complete assembly of finished aircraft. The industry is so recognized by U.S. Government classification and by industry and financial authorities.

The author's approach to this study is historical, and the subject matter is presented as a comprehensive chronological survey of aircraft manufacture from 1914 to 1951, with an understanding and full discussion of the locational influences that controlled the regional shift, decentralization, and final determination of its outstanding production centers.

The work is divided into four sections and begins with a description of the development of the industry since its inception in 1914. It traces the growth of the industry and the background of its locational problems during the succeeding 25 years, emphasizing the many influences resulting in its status as of 1940.

This is followed by a discussion of the changes brought about by the demands of the U.S. Government during World War II. The author then outlines the readjustments and changes that took place during the post-war period and, finally, the influences currently changing the locational centers of the larger aircraft manufacturing units as demanded by the Armed Forces and required by the Government's defense measures.

No attempt is made to define a set of specifications governing the selection of a location and a site for a plant engaged in the manufacture of aircraft. Instead, the author sets forth in considerable detail the criteria that have been and are currently used for measuring the desirable geographic distribution of the industry and the factors governing specific locations. He leaves to the reader the weighing of the many variables to be considered in determining the location of any large segment of the industry, including the requirements of the Government and the demands of the Armed Services.



Five Sound Reasons...

for America's Air Might

All of these first-line fighters combine flashing speed with top dependability—characteristics that mark them as outstanding military aircraft. Significantly, each is powered by two Westinghouse turbojet engines.

In addition to the already famous J34, Westinghouse research and engineering skill has developed the J46 and the J40, big brother of the Westinghouse jet engine family and the most powerful turbojet engine known to be in production anywhere.

Look for Westinghouse to continue to power the outstanding military aircraft of the future. Look to Westinghouse for constant progress in the development of more powerful and more reliable turbojet engines.

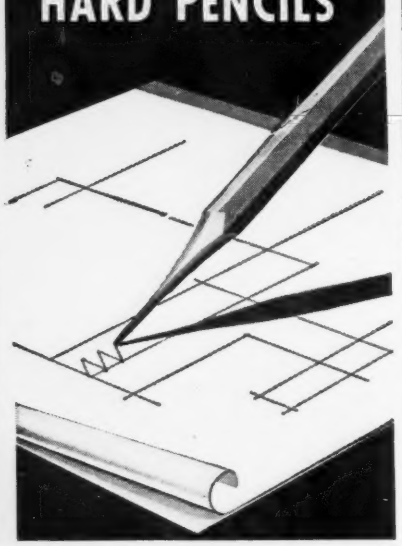
J-54010

YOU CAN BE SURE...IF IT'S

Westinghouse

AVIATION GAS TURBINES

Imperial
TRACING CLOTH FOR HARD PENCILS



• Imperial Pencil Tracing Cloth has the same superbly uniform cloth foundation and transparency as the world famous Imperial Tracing Cloth. But it is distinguished by its special dull drawing surface, on which hard pencils can be used, giving clean, sharp, opaque, non-smudging lines.

Erasures are made easily, without damage. It gives sharp, contrasting prints of the finest lines. It resists the effects of time and wear, and does not become brittle or opaque.

Imperial Pencil Tracing Cloth is right for ink drawings as well.

Imperial
PENCIL TRACING CLOTH
SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE.

The book contains numerous maps of the locations of aircraft assembly plants and of engine and propeller plants. It includes many valuable tables of manufacturing floor areas in use; the employment in air-frame, engine and propeller plants by metropolitan districts, cities, and towns; and the current total of such employment by census regions and states.

This book should prove an interesting addition to the library of anyone allied with the management or financing of the aircraft industry.

GEORGE S. ARMSTRONG
Consulting Engineer
New York, N.Y.

Book Notes

AIRPLANE DESIGN

British Civil Airworthiness Requirements; Section A, General Information and Procedure. Gt. Brit., Air Registration Board. London, Air Registration Board, 1951. 59 pp., diagrs. 5*s.* 6*d.*

AIRPORTS

Obstruction Marking, the Painting and Lighting of Structures Which Are Potential Hazards to Air Commerce. U.S., Civil Aeronautics Administration. Washington, Supt. of Documents, 1951. 27 pp., illus., diagrs. $0.20.

COMFORTIZATION

Heating, Ventilating, Air Conditioning Guide, 1951. New York 10, American Society of Heating and Ventilating Engineers, 1951. 1,456 pp., illus., diagrs. $7.50.

The first four sections deal with Fundamentals, including Thermodynamics, Fluid Flow, and Heat Transfer; Human Reactions; Heating and Cooling Loads; and Combustion and Consumption of Fuels. A large section of 25 chapters follows on Systems and Equipment, and the two final sections deal with Special Systems and Instruments and Codes. The chapter on Transportation Air Conditioning includes aircraft heating, cooling, and ventilating (pp. 987–990). There is an extensive Catalog Data Section (pp. 1057–1456).

EDUCATION & TRAINING

Training Manual. (International Civil Aviation Organization, Document No. 7192-AN/857.) Montreal, International Civil Aviation Organization, 1951. Part I, 29 pp., $0.15; Part 3, 127 pp., $0.60.

This manual is based upon the existing practices and training organizations in a number of contracting states. Part I is concerned with general principles and considerations applicable to most forms of aviation training. Part 3 is a detailed discussion of the training of the commercial pilot and includes the curriculum, training equipment, training aids such as textbooks and motion pictures, length of training required, examination procedures, and typical examination questions. A number of other parts is planned for publication.

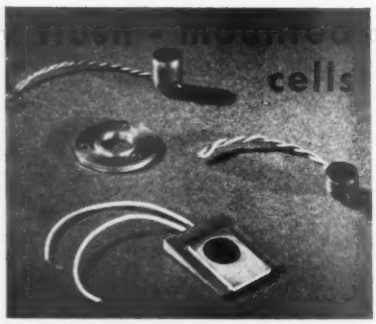
Flight Instruction Manual. (U.S., Civil Aeronautics Administration, Technical Manual No. 100.) Washington, Supt. of Documents, 1951. 184 pp., diagrs. $1.50.

ELECTRONICS

Traveling Waves on Transmission Systems. L. V. Bewley. 2nd Ed. New York, John Wiley & Sons, Inc., 1951. 543 pp., diagrs. $12.

This textbook was originally published in 1933. The present edition, larger by more than 200

For TRUE dynamic air-pressure measurements of flutter, buffeting, and gust loads. Automatic-zero circuit corrects for static-temperature and pressure variations, gives real unattended operation. High gain with low noise combine sensitivity with clean hash-free oscillograph records.



Flush-mounted pressure cells in a wide variety of forms and dynamic ranges give TRUE phase and amplitude measurements. Insensitive to vibration and acceleration. Diameters as small as ⅜ in. Mount as close as ½ in. from trailing edge. No error-inducing connecting tubes or instrument volume. Send for full information on your particular problem.

ELECTRONIC ENGINEERING ASSOCIATES, LTD.
1042 Brittan Avenue
San Carlos, California

pages, collects into organized form the theories of transient voltage phenomena on electric power transmission lines and in transformer windings. The Origin, Characteristics, and Behavior of Traveling Waves are discussed in Part I, with particular attention to lightning research. The final chapter of this part deals with routine procedures for the design of lightning-proof transmission lines. Part 2 takes up High-Frequency Oscillations and Terminal Transients of Transformers, ending with a chapter on Suppression of Internal Oscillations by Electrostatic Shielding. A knowledge of the operational calculus is required of the reader. The author is Professor and Director of Curriculum in Electrical Engineering at Lehigh University.

British Civil Airworthiness Requirements; Section R, Radio. Gt. Brit., Air Registration Board. London, Air Registration Board, 1951. 22 pp., diagrs. 2*s*. 6*d*.

Fundamentals of Electronics. F. H. Mitchell. Cambridge, Mass., Addison Wesley Press, Inc., 1951. 243 pp., illus., diagrs. $4.50.

In this textbook, electronics is considered to be "the study of the motion of electrons in fields of force," with concentration upon the free electron. The student is expected to have a knowledge of general physics, algebra, and trigonometry. The use of simpler operations of the calculus—for example, in the treatment of differentiating and integrating circuits—is followed through geometric interpretations in the text. Following introductory chapters on electric circuits and electron emission, the discussion takes up the vacuum diode and its use as a rectifier, the vacuum triode and its use as a voltage amplifier, multielectrode tubes, multistage and power amplifiers, sine-wave oscillators, gas-filled tubes, and special-purpose tubes and devices. The final chapters discuss wave shaping, control circuits, and applications of the electronic voltmeter and the cathode-ray oscilloscope in instrumentation. The author is Professor of Physics at the University of Alabama.

INSTRUMENTS

Resistance Strain Gauges, Their Construction and Use. J. Yarnell. London, W.C. 2, Offices of *Electronic Engineering*, 1951. 128 pp., illus., diagrs. 12*s*. 6*d*.

The construction of wire-wound strain gages is described and followed by chapters on cements, bridge theory, circuits and methods, slip-rings, and strain-sensitive lacquer. The final chapters deal with Stress and Strain in Two Dimensions and The Measurement of Two-Dimensional Strains. The book is designed as an introduction for experimental engineers and designers who wish to make use of the strain-gage method and for beginners in engineering training who wish to understand the principles of the method and its limitations and possibilities. Much of the information derives from the author's experience in the Vibration Department of de Havilland Propellers, Ltd.

Bibliography of Information on Servomechanisms and Related Subjects. (Gt. Brit., Interdepartmental Committee on Servomechanisms.) Nottingham, Kent, England, Ministry of Supply (TPA3/TIB), 1951. 138 pp.

About 600 abstracts are listed, classified in Part I under General Theory, Analysis and Design of Control Systems and Associated Instruments, Components and Sub-Units of Control Systems, Applications, and Tests and Performance. In Part II the references deal with Manual Tracking, including Manual Control, Tracking, and Equipment and Applications. The material is further classified under the main headings into about 90 detailed subheadings. An index of authors is included. This bibliography is based upon reports, journals, and books in the Servo Library of the Ministry of Supply in Nottingham which are security unclassified.

MACHINE ELEMENTS

Principles of Mechanism. F. Dyson. 4th Ed. London and New York, Oxford University Press, 1951. 368 pp., diagrs. $3.00.

PAN AMERICAN WORLD AIRWAYS
AMERICAN AIRLINES
WESTERN AIR LINES
MID-CONTINENT AIRLINES
PRESSURE
SWITCHES are known by the customers they serve
Today, more airlines prefer Meletron pressure actuated switches than ever before. Their experience with Meletron instruments is proof of this statement:
Wherever a system calls for control, actuated by pressure changes, there is a Meletron product to handle the job.
UNITED AIR LINES
Capital AIRLINES
MELETRON®
PRESSURE ACTUATED SWITCH
MELETRON® CORPORATION
950 NORTH HIGHLAND AVENUE, LOS ANGELES 38, CALIFORNIA

J. M. Walthew Co., Boeing Field, Seattle. James R. Thomson, 708 Hemphill Street, Fort Worth. Rousseau Engineering & Sales, Montreal Airport, Dorval, Canada.

This textbook was last revised in 1939. The original purpose—to supply a text on the fundamental principles applying to the moving parts of machines for engineering students studying for the first part of the examinations for the engineering degree—is retained. In the present edition, the appendix has been revised and enlarged, and a system of notation has been adopted for the Coriolis component of acceleration. The author is Lecturer in Mechanical Engineering at the Imperial College of Science and Technology, London.

Die Trägfahigkeit der Zahnräder. A. K. Thomas. Munich, Carl Hanser Verlag, 1950. 175 pp., diagrs. DM 12.

A systematic method is presented for the calculation of stresses in gears and gear drives. Bevel gears with straight and with oblique teeth, spur gears, worm gears, and helical gears are considered. Geometric calculations for each type of gear are discussed in detail. A bibliography of 25 references to German books, articles, and standards is included. The book is intended for engineers, manufacturers, designers, and students.

Fasteners Data Book. Cleveland 15, Industrial Fasteners Institute, 1950. 208 pp., illus., diagrs. $3.75.

About 60 technical articles are reprinted from the publication *Fasteners*, on the engineering, design, and use of bolts, nuts, rivets, screws, and special headed and threaded products. These papers cover a wide variety of industrial practices and present considerable technical data resulting from original research, as reported by specialists.

MATERIALS

Sandwich Construction for Aircraft, Part II. U.S., Munitions Board, Subcommittee on Air Force-Navy-Civil Aircraft Design Criteria. Washington, Supt. of Documents, 1951. 101 pp., diagrs. $0.50.

Design of Wood Aircraft Structures. (U.S. Munitions Board, Subcommittee on Air Force-Navy-Civil Aircraft Design Criteria, ANC Bulletin No. 18.) 2nd Ed. Washington, Supt. of Documents, 1951. 234 pp., illus., diagrs. $1.00.

A Bibliographical Survey of the Development and Use of Substitute Materials for Non-Ferrous Metals and Alloy Steels in Germany. (Gt. Brit., Department of Scientific and Industrial Research, Technical Information and Documents Unit, Report No. RMS-2.) London, H.M. Stationery Office, 1951. 46 pp. 1*s.* 6*d.*

Non-Ferrous Metals: Year Book of Associations and Technical Publications of O.E.E.C. Countries, Canada and the United States. Paris, Organisation for European Economic Co-Operation, 1951. 92 pp. $0.90.

A Handbook of Synthetic Rubber Packings. 4th Ed. Philadelphia, E. F. Houghton & Company, 1950. 110 pp., illus., diagrs.

Magnetic Materials. F. Brailsford. London, Methuen & Company, Ltd.; New York, John Wiley & Sons, Inc., 1951. 156 pp., diagrs. $1.50.

This book was originally published in 1948. In the present edition, the text has been corrected and amended in several minor respects, and some recent references have been added. The purpose of the book is to provide for the advanced student, the research worker, and those concerned with the technological applications of magnetic materials, an outline of the present state of knowledge of the subject. The author is associated with the Research Department of the Metropolitan-Vickers Electrical Company, Ltd.

Phase Transformations in Solids. Symposium Held at Cornell University, August 23–26, 1948. Editorial Committee: R. Smoluchowski, Chairman, J. E. Mayer, W. A. Weyl. Sponsored by The Committee on Solids, Division of Physical Sciences, The National Research Council. New York, John Wiley & Sons, Inc., 1951. 660 pp., illus., diagrs. $9.50.

Contents: On the General Theory of Phase Transitions, Laszlo Tisza. A General Method for Imperfect Crystals and Phase Transitions, Joseph E. Mayer. Crystallization As a Cooperative Phenomenon, John G. Kirkwood. Fundamental Aspects of Diffusion in Solids, Frederick Seitz. Nucleation Theory, R. Smoluchowski. Crystallographic Aspects of Phase Transformations, M. J. Buerger. The Solid-Liquid Transition in Argon, O. K. Rice. Transitions in Silver Halides, M. L. Huggins. Phase Transformations in One-Component Silicate, F. C. Kracek. Phase Transformations in Polycomponent Silicate Systems, J. F. Schairer. Transitions in Glass, Woldemar A. Weyl. Phase Transitions in Ferroelectrics, Bernd Matthias. Transformations in Pure Metals, Charles S. Barrett. Order-Disorder Transitions in Metal Alloys, Sidney Siegel. Precipitation from Solid Solutions of Metals, A. H. Geisler. The Eutectoid Reaction, Robert F. Mehl and Arthur Dubé. The Martensite Transformation, Morris Cohen.

Cutting Tool Materials. Eric N. Simons. London, Sir Isaac Pitman & Sons, Ltd., 1951. 180 pp., illus. 21*s.*

The author's purpose is to present a guide to the different classes of steels and alloys for cutting tools, including their basic composition, heat-treatment, and applications. There are separate chapters on Alloy Die Steels, Alloy Steels for Chisels, Miscellaneous Alloy Tool Steels, as well as Alloy-Free Carbon Tool Steels, High-Speed Tool Steels, and Alloy Steels for Plastic Moulds and Hobs. Such new developments as butt-welded cutting tools and deposit-welded high-speed steel tools are covered, and there is a good chapter on Stellite. The final chapters deal with grinding and testing. A detailed list of tools and the recommended materials suitable for each is included in an appendix, cross-referenced to composition tables and to appropriate material in the text. Appendixes also cover standard shank sections, lengths and shapes, and general recommendations for tungsten-carbide-tipped cutting tools.

NAVIGATION

Navigation Problems and Solutions. Ramon O. Williams and George W. Mixter. New York, D. Van Nostrand Company, Inc., 1951. 162 pp., diagrs. $5.00.

This book is designed as a practical aid for instructors or for self-study with any standard textbook. Problems in dead reckoning, Sumner line work, moon sight problems, latitude by Polaris, solutions for line of position, work with the sun, three star fixes, planet and moon work are included. There is a large section (pp. 99–155) of practical problems at sea, and a final section on maneuvers to plot. The required excerpts from the *Nautical Almanac*, *Air Almanac*, and navigation tables are included.

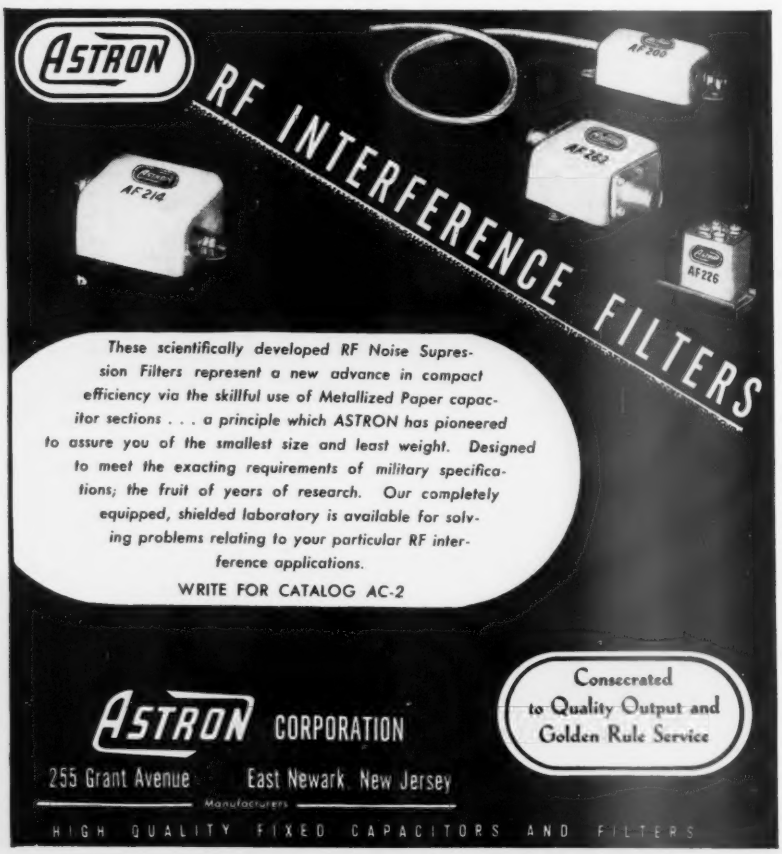
PHOTOGRAPHY

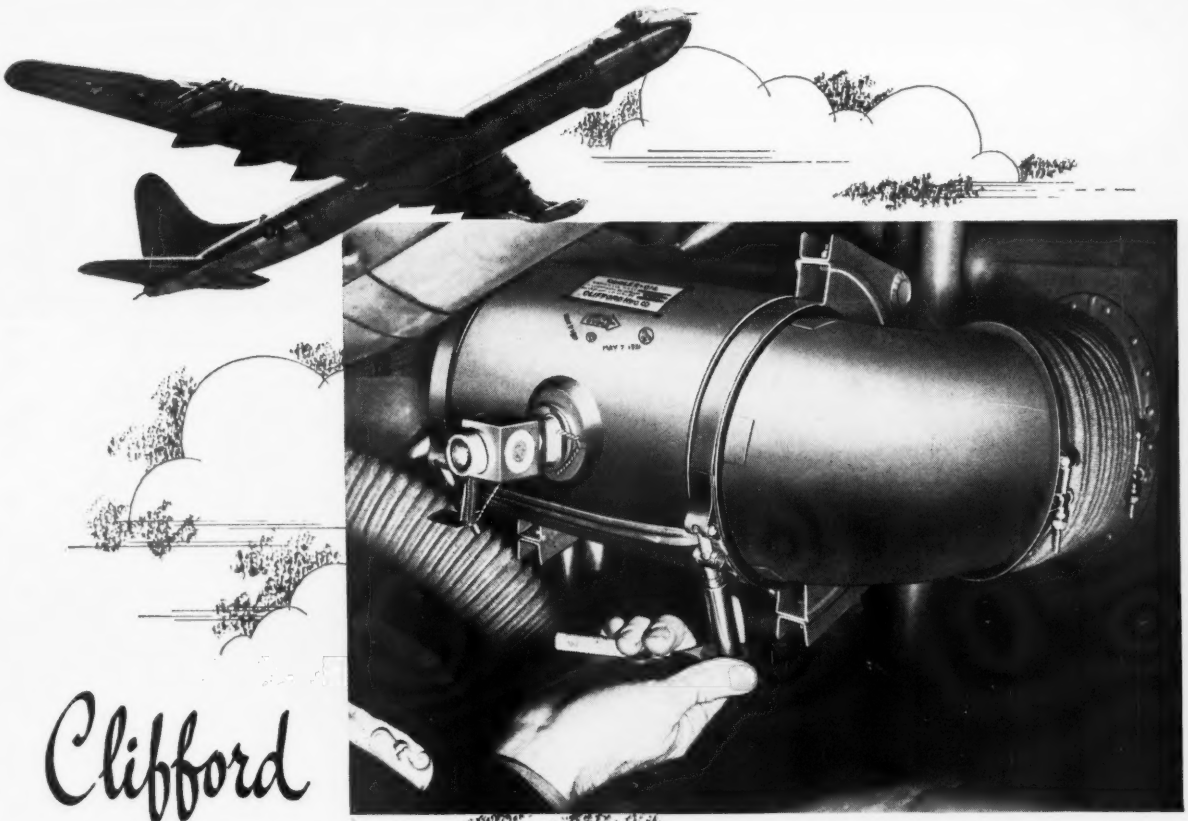
Photographie Instantanée et Cinématographie Ultra-Rapide. P. Fayolle and P. Naslin. Paris 15, France, Éditions de la *Revue d'Optique*, 1950. 188 pp., illus., diagrs.

The first part presents a complete survey of optical methods used in speed photography. Shadow photography and interferometry are discussed, and the schlieren method is discussed in detail. The greater part of the book is concerned with the principles, equipment, and methods of high-speed still and motion-picture photography. The aim of the authors is to provide a systematic account of the subject for those employing high-speed photography in its many applications. The authors are, respectively, Principal Military Engineer and First Class Military Engineer in the national Fabrications d'Armement.

Stereoptics, an Introduction. Leslie P. Dudley. London and New York, Macdonald & Company (Publishers) Ltd., 1951. 112 pp., illus., diagrs. $3.25.

The application of stereoscopic three-dimensional principles to still and motion-picture photography and radiography is discussed. The first


ASTRON
RF INTERFERENCE FILTERS
AF 214
AF 203
AF 226
These scientifically developed RF Noise Supression Filters represent a new advance in compact efficiency via the skillful use of Metallized Paper capacitor sections . . . a principle which ASTRON has pioneered to assure you of the smallest size and least weight. Designed to meet the exacting requirements of military specifications; the fruit of years of research. Our completely equipped, shielded laboratory is available for solving problems relating to your particular RF interference applications.
WRITE FOR CATALOG AC-2
ASTRON CORPORATION
255 Grant Avenue East Newark, New Jersey
Manufacturers
HIGH QUALITY FIXED CAPACITORS AND FILTERS
Consecrated to Quality Output and Golden Rule Service



Clifford Feather Weights Cool the Oil in CONVAIR B-36D BOMBERS

WORLD'S LARGEST BOMBER, the Convair B-36D, has a 10,000 mile range and a ceiling of over 45,000 feet.

It uses a Clifford oil cooler to get rid of the heat generated in the constant speed drive which links the engine to the 400 cycle alternator. The oil cooler is essential to the proper operation of the unit under the varying conditions of takeoff and flight, and permits the use of a smaller size and lower weight drive.

Conventional or jet powered, civilian airliner or world's largest bomber . . . all types of modern aircraft depend on Clifford Feather Weight All-Aluminum Oil Coolers . . . *the only all-brazed type* of oil coolers. Their superior weight-strength ratio is achieved through Clifford's patented brazing method and pre-testing in Clifford's wind tunnel laboratory . . . the largest and most modern in the aeronautical heat exchanger industry. For further details, write Clifford Manufacturing Company, 138 Grove Street, Waltham 54, Mass. *Division of Standard-Thomson Corporation.* Sales offices in New York 17, Detroit, Chicago 1, Los Angeles.

CLIFFORD

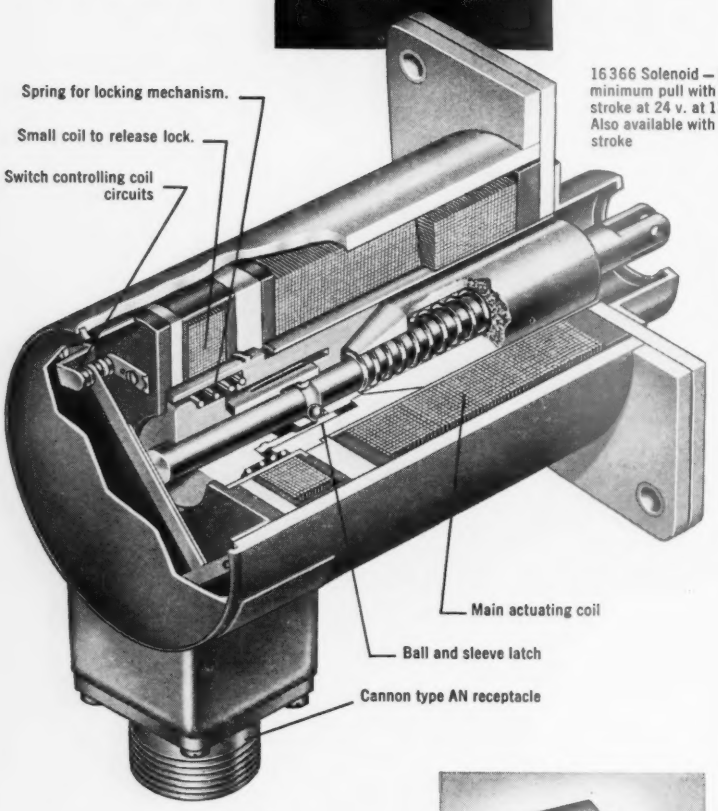
HYDRON Metal Bellows

ALL-ALUMINUM OIL COOLERS FOR AIRCRAFT ENGINES

HYDRAULICALLY-FORMED BELLOWS AND BELLOWS ASSEMBLIES

Here's why those in the know

—demand **CANNON SOLENOIDS**

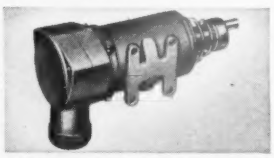

Spring for locking mechanism.
Small coil to release lock.
Switch controlling coil circuits
16366 Solenoid—18.7 lb. minimum pull with 1/2" stroke at 24 v. at 170°F. Also available with 1-1/6" stroke
Main actuating coil
Ball and sleeve latch
Cannon type AN receptacle

Here's a special purpose Cannon D.C. Solenoid, #16366 for aircraft. Design and safety conditions require that the armature lock in the actuated position for an indefinite time, without relying on a continuous flow of current.

The ingenious ball-and-sleeve latch locks the armature as the main coil circuit is broken through the built-in switch. When current is applied to the smaller coil, motion of the sleeve releases the main armature. Study of the drawing shows how a smooth-acting, positive lock is accomplished.

This is one of more than 60 different Cannon D.C. Solenoids built around 18 basic coils for either continuous or intermittent service. Write for Solenoid Bulletin free on request.

#1154 an intermittent service solenoid, 12v, D.C.—10.5 amps.—stroke 9/32", weight 13 oz.



#4440 a continuous service solenoid, 24v, D.C.—3.6 amp. (starting) .42 amp. (holding)—stroke 3/8" weight 16 oz.

11790 a continuous service solenoid, 24v, D.C.—3.6 amp. (starting) .42 amp. (holding)—stroke 3/8" weight 15.5 oz.

CANNON ELECTRIC

Since 1915

CANNON ELECTRIC COMPANY
LOS ANGELES 13, CALIFORNIA

Factories in Los Angeles, Toronto, New Haven. Great Lakes Division, Benton Harbor, Mich. Representatives in principal cities. Address inquiries to Cannon Electric Co., Dept. J-000, P. O. Box 75, Lincoln Heights Sta., Los Angeles 31, Calif.

part deals with processes requiring a viewing device, including polarized light and anaglyphic processes using complementary color filters. The second part is concerned with autostereoscopic processes requiring no viewing devices, including parallax stereogram processes, parallax panoramagram and integral processes, and stereoscopic radiography. The author's researches are fully described, and historical developments are included.

PRODUCTION

Aircraft Mechanic's Pocket Manual. Joseph A. Ashkouti. 4th Ed. New York, Pitman Publishing Corporation, 1951. 198 pp., diagrs. $2.50.

This widely used manual, designed for frequent reference use, was last revised in 1944. In the present edition, sections on Aircraft Identification Standards, Materials of Construction, and Standard AN Parts have been completely revised. Other sections include flat pattern layout, aircraft finishes, screw and pipe threads, drilled and reamed holes, tools, stress fundamentals for structural repairs, and processes for fabrication of plastic parts.

Production Engineering Administration and Management. J. V. Connolly. London, *Aircraft Engineering*, 1951. 48 pp., illus., diagrs. 5s.

A series of eight articles on the economics of production for aeronautical engineers which appeared in *Aircraft Engineering* in 1950 and 1951 is reprinted here. The author is Professor of Aircraft Economics and Production at the College of Aeronautics, Cranfield. A bibliography of 111 references is included.

Quality-Control Handbook. Edited by J. M. Juran. New York, McGraw-Hill Book Company, Inc., 1951. 800 pp., illus., diagrs. $10.

The first nine chapters deal with economics, specifications, organization, acceptance, control, assurance, statistical methods, paper work, and applications of electric accounting machines to quality control. The final chapters are concerned with quality control in textile production, chemical process industries, aircraft production, electron-tube production, and screw-machine operations. There are separate discussions on Vendor Inspection and Introducing Statistical Quality Control in a Going Plant, by Dorian Shainin, Chief Inspector, Hamilton Standard Division, United Aircraft Corporation. Quality Control in Aircraft Manufacture is discussed by John G. Rutherford, Assistant Chief Inspector, The Glenn L. Martin Company. While footnote references or bibliographies do not accompany the chapters mentioned, most chapters are amply documented—for example, the chapter on the chemical process industries includes a list of more than 100 references. References to aircraft industry practices are found in various of the introductory chapters. This is the first handbook of the subject. It is comprehensive and should be useful to executives, supervisors, and engineers for the training of quality control personnel, and as a textbook in engineering and management courses. The editor is a consulting management engineer and is Adjunct Professor of Management Engineering at New York University.

Directory of Metalworking Machinery. (U.S., Munitions Board, Cataloging Agency.) Washington, Supt. of Documents, 1951. 795 pp. $3.50.

The machine tools manufactured by a large number of companies are listed. A short description of each machine tool, the manufacturer's model number, its size and capacity, its standard commodity code number, and its manufacturer and model code number are included. Over 1,050 machine-tool manufacturers and their products are listed.

Welding, Joining and Cutting of Gray Iron. C. O. Burgess. Cleveland 14, Gray Iron Founders' Society, Inc., 1951. 37 pp., illus. $1.50.

This discussion is concerned only with elevated-temperature methods, omitting standard room-temperature methods of joining or cutting. Gas and arc welding, brazing, soldering, special welding methods (thermit, flash, and pressure welding), bimetal casting, and torch and arc cutting

DYNAMIC ANALYSIS

Opportunities for men qualified to head group engaged in Guided Missiles guidance systems, analysis and design, Servo-Mechanism Theory, Aero Elasticity and simulator work. A prominent and responsible position for a man with applicable technical, supervisory and leadership qualifications.

•

Write in confidence to

Mr. Ralph Bickford,
Industrial Relations Manager

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Guided Missiles Division
FARMINGDALE, L. I., N. Y.

are described. A bibliography of 55 items is included.

PUNCHED CARDS

Punched Cards, Their Applications to Science and Industry. Edited by Robert S. Casey and James W. Perry. New York, Reinhold Publishing Corporation, 1951. 506 pp., illus. $10.

This is the first comprehensive survey of what is known about punched-card systems and what is being done with them. The authors' primary purpose is to provide sufficient information for the individual scientist to apply punched-card techniques to individual problems, with particular emphasis upon hand-sorted edge-punched cards. Full attention to the machine-sorted systems is not within the scope of the book. The book consists of 29 papers, arranged in four groups. The first group of four papers deals with such fundamentals as elementary manipulations, simple coding procedures, and commercially available systems, equipment, and supplies. Part II contains 14 papers describing case histories of punched-card applications. The next 10 papers cover general and theoretical problems, including discussions of coding, index and literature searching, classification, transcription problems, and applications to scientific computations. Future possibilities of applying mechanized methods to scientific and technical literature are discussed in the final paper. A bibliography of 276 references on uses of punched cards is included. An index of authors is provided. This book can be highly recommended as an authoritative and carefully prepared reference on the subject.

REFERENCE WORKS

Bibliography of Interlingual Scientific and Technical Dictionaries. J. E. Holmstrom. *Paris, United Nations Educational, Scientific and Cultural Organization;* New York, Columbia University Press, 1951. 220 pp. $0.65.

RESEARCH

Techniques Générales du Laboratoire de Physique. J. Surugue, Editor. Paris 7, Center National de la Recherche Scientifique, 1947–1950. 2 Vols.; 433, 336 pp. 1,500, 900 fr.

Contents: Volume I—Principes de Construction des Appareils Scientifiques, H. Gondet. Principales Opérations du Soufflage du Verre, Ch. Amate. Technique du Vide, J. Surugue. Réalization des Hautes Températures, G. Ribaud. Techniques Générales d'Optique, A. Arnulf. Sources de Lumière et Filtres, G. Dupuy. Cellules Photoélectriques, A. Lallemand and M. Munsch. Procédés d'Enregistrement, H. Gondet. Régulation et Redressement des Tensions et des Courants, M. Demontvignier. Volume II—Instruments et Méthodes pour la Mesure de l'Énergie Rayonnante, J. Lecomte. Fils Fins en Silice et à la Wollaston, T. T. Ouang. Membranes Très Minces en Dérivés Cellulosiques, I. Dlongoch. Électromètres, J. Surugue. Lampes Électromètres, A. Rogozinski. Comptage et Sélection des Particules Ionisantes, R. Maze. Technique des Analogies Électriques, L. Malavard. Micromanipulation, P. de Fonbrune. Réglage Automatique de la Température, R. Leduc.

Government Scientific Organisation in the Civilian Field. (Gt. Brit., Advisory Council on Scientific Policy.) London, H.M. Stationery Office; New York, British Information Services, 1951. 47 pp. $0.40.

SCIENCES, GENERAL

MATHEMATICS

The Algebra of Vectors and Matrices. Thomas L. Wade. Cambridge 42, Mass., Addison-Wesley Press, Inc., 1951. 189 pp. $4.50.

The author's purpose is to supply an elementary textbook on the algebra of vectors and matrices. While a setting of such basic ideas of modern algebra as group, integral domain, field, ring, basis, dimension, and isomorphism is pro-

AIRSURANCE
Airline Passenger Insurance
Annual Policies
from $5,000 to $100,000
at new low rates
No Physical Examination • No Age Limit

EXAMPLE
$25,000.00 for death or dismemberment
$1,000.00 for Hospital and Doctor's bills
$50.00 per week when disabled
PREMIUM $38.00 per year

Policies cover all airlines in U. S. and American Flag lines world-wide — also airlines in Canada, Mexico and South America which meet safe operating standards.

Backed by the Combined Assets of
Aetna Casualty & Surety Co.
American Surety Co. of N. Y.
Century Indemnity Company
Hartford Accident & Indemnity Co.
Maryland Casualty Co.
Massachusetts Bonding & Insurance Co.
New Amsterdam Casualty Co.
Standard Accident Insurance Company
Travelers Indemnity Co.
United States Fidelity & Guaranty Co.

U.S. GROUP
WRITE OR PHONE ANY U. S. GROUP OFFICE

UNITED STATES AVIATION UNDERWRITERS
INCORPORATED
80 JOHN ST. • NEW YORK 38, N. Y.
ATLANTA • CHICAGO • DALLAS • KANSAS CITY
LOS ANGELES • SAN FRANCISCO

CHIEF PROJECT ENGINEER
and
CHIEF TEST ENGINEER

To work with a small group of Engineers on aircraft pumps and accessories.

CHIEF PROJECT ENGINEER to be in complete charge of Engineering Department and supervise basic designs of aircraft, fuel, vacuum, hydraulic and air pumps. Capable of advancing to Assistant Chief Engineer.

CHIEF TEST ENGINEER to be in complete charge of Experimental Test Laboratory, supervise testing, write test reports, etc.

Prior experience in the aircraft pump field essential. Must be Engineering graduate. Must have had supervisory experience. Submit personal history including education, work experience, and references to our Chief Engineer. Write in confidence.

LEAR, INCORPORATED
Romec Division, Elyria, Ohio Phone 2271

vided, the applied scientist or the mathematician interested mainly in analysis will perhaps wish to concentrate upon the essentials of matrix algebra as preparation for more advanced work in matrix and tensor calculus. The summation notation, the index symbolism, and transformat'ons, which are common in tensor theory, are used considerably in this book. There is a bibliography of about 35 books and papers of more advanced nature. The book is an outgrowth of a trial edition based upon courses taught by the author at Florida State University.

Tables of $n!$ and $\Gamma(n + \frac{1}{2})$ for the first Thousand Values of n. Herbert E. Salzer. (U.S., National Bureau of Standards, Applied Mathematics Series, No. 16.) Washington, Supt. of documents, 1951. 10 pp. $0.15.

Einführung in die kombinatorische Topologie. Kurt Reidemeister. (Brunswick, 1932.) New York, Frederick Ungar Publishing Company, 1951. 209 pp. $3.50.

Dr. Reidemeister's standard introductory text was first published in 1932 and is here reprinted. Infinite groups are discussed in the first three chapters, and the final four chapters discuss the line and surface complexes, and especially the two-dimensional manifold.

Monte Carlo Method. Proceedings of a Symposium Held June 29, 30 and July 1, 1949, in Los Angeles, California, under the sponsorship of The RAND Corporation and the National Bureau of Standards, with the cooperation of the Oak Ridge National Laboratory. (U.S., National Bureau of Standards, Applied Mathematics Series, No. 12.) Washington, Supt. of Documents, 1951. 42 pp., diagrs. $0.30.

Fourteen papers are presented on principles and applications of the Monte Carlo method, which combines sampling theory and numerical analysis.

Introduction to Number Theory. Trygve Nagell. New York, John Wiley & Sons, Inc., 1951. 309 pp. $5.00.

Based upon lectures given by the author during the last thirty years, this book provides an introduction to the elementary theory of numbers. New material has been included, such as the elementary proof of the prime number theorem put forward in 1948 by Atle Selberg of the Institute for Advanced Study at Princeton University. A knowledge of college algebra is required of the reader. About 180 problems are included. The author is Head of the Department of Mathematics at the University of Uppsala in Sweden.

Nomographic Charts. C. Albert Kulmann. New York, McGraw-Hill Book Company, Inc., 1951. 244 pp., diagrs. $6.50.

A collection of 92 nomographic charts is presented, as used by the author in engineering practice for a number of years. These time-saving devices are arranged in six groups: Function Scales, General Charts, Hydraulics Charts, Mechanics Charts, Thermodynamics Charts, and Electrical Charts. Chart scalings take into account the modification of factors by exponential functions, empiric multipliers, and similar variations. Typical charts in mechanics and thermodynamics cover column loading, compression springs, torsional moment and stress, gas expansion, and heat loss by incomplete combustion. Each chart is accompanied by an explanation of its use.

Tensor Analysis for Physicists. J. A. Schouten. London and New York, Oxford University Press, 1951. 275 pp. $6.00.

The theory of the calculus as it is needed for physical purposes is developed in the first five chapters, which cover the tensor algebra and the tensor analysis. A summary of these chapters is provided on pages 110–125. Applications are taken up in the next chapters on Physical Objects and Their Dimensions, Applications to the Theory of Elasticity, Classical Dynamics, and Relativity. The final chapter covers the latest developments of the matrix calculus for quantum mechanics as worked out by P. A. M. Dirac. A bibliography of about 80 references is included. The author's lectures at the University of Delft and at Amsterdam University, where he is now Professor of Mathematics, form the basis for the book.

Dictionary of Mathematical Sciences; Volume 1, German-English. Leo Herland. New York, Frederick Ungar Publishing Company, 1951. 235 pp. $3.25.

More than 6,500 terms centering about the subjects of mathematics and geometry are included. Such fields of application as mathematical logic, statistics, physics, and astronomy are included. Only meanings having mathematical significance are included, but numerous applied mathematics terms result in the various combinations with such terms as Fläche, Rotation, Strahl, Schraube, Kugel, Winkel, and Schmiegsam. The number of cross references is unusually large. This dictionary is highly recommended.

MECHANICS

Classical Mechanics. Herbert Holdstein. Cambridge 42, Mass., Addison-Wesley Press, Inc., 1951. 399 pp. $7.00.

The purpose of the author is to present a textbook to serve new requirements. Classical mechanics is considered basic for the various branches of modern physics, offering the student an opportunity to master the mathematical techniques necessary for quantum mechanics while working with familiar concepts. Examples are the use of the Hamilton-Jacobi equation and the principle of least action in the transition to wave mechanics, the technique of action-angle variables for the older quantum mechanics, Poisson brackets and canonical transformations for the newer quantum mechanics, and matrix transformations for rigid-body rotations. Unified mathematical treatment is therefore possible for such diverse topics as the inertia tensor, Lorentz transformations in Minkowski space, and resonant frequencies of small oscillations. Chapter 6 deals with special relativity, and an elementary description of the Lagrangian and Hamiltonian formulations for continuous systems and fields is given in the last chapter. A bibliography of 71 books is included. The book is based upon a course of lectures on classical mechanics given by the author at Harvard University.

PHYSICS

An Introduction to Acoustics. Robert H. Randall. Cambridge 42, Mass., Addison-Wesley Press, Inc., 1951. 340 pp., illus., diagrs. $6.00.

The author's purpose is to provide an intermediate textbook for undergraduate students who have completed a general course in physics and a year of calculus. Fundamental Particle Vibration Theory is discussed after the introduction, leading into discussions of Plane Waves in the Air and Waves in Three Dimensions. Two chapters then take up Interference Patterns and Acoustic Impedance, after which Longitudinal Waves in Different Gases, Waves in Liquids and Solids, and Stationary Waves are discussed. Four succeeding chapters deal with Reflection and Absorption of Sound Waves, Speech and Hearing, Sound Measurements, and Reproduction of Sound. The final chapter discusses various applications of acoustics. There is a bibliography of about 14 books and 50 references. The author is Associate Professor of Physics at The City College of New York.

STANDARDS

British Standards Institution Yearbook, 1951. London, S.W. 1, British Standards Institution, 1951. 399 pp. 7*s*. 6*d*.

The greater part of this volume consists of numerical lists of British Standards in effect as of December 31, 1950. Lists of amendments issued since 1949 and of withdrawn standards are included. Each standard in the numerical list is summarized. There is a detailed index of subjects. The first part of the book describes the work of the British Standards Institution and includes the names of members of all its committees.

Fifty Years of British Standards, 1901–1951. London, S.W. 1, The British Standards Institution, 1951. 103 pp.

The origin, growth, work, and organization of the British Standards Institution during its first 50 years.

THERMODYNAMICS

Report of Research and Technologic Work on Explosives, Explosions, and Flames, Fiscal Year 1950. Bernard Lewis. (U.S., Bureau of Mines, Report of Investigations No. 4793.) Pittsburgh, Pa., 1951. 67 pp.

Thermodynamics from a Generalized Standpoint. Joseph Louis Finck. Brooklyn 25, N.Y., 440 Rogers Ave., Flatbush Publications, 1951. 124 pp. $4.00.

The author's researches are presented in unified form, introducing the concept of a "complete" system, the behavior of which is extended to metastable as well as to the ordinary stable states. The behavior of liquid helium at low temperatures, the acquiring by systems of such dissipative properties as viscosity and electric and thermal resistance, and the reason for the vanishing of these properties in some cases at absolute zero of temperature, are among the phenomena explained. A list of Dr. Finck's published papers from 1931 to 1949, upon which the discussion is based, is included.

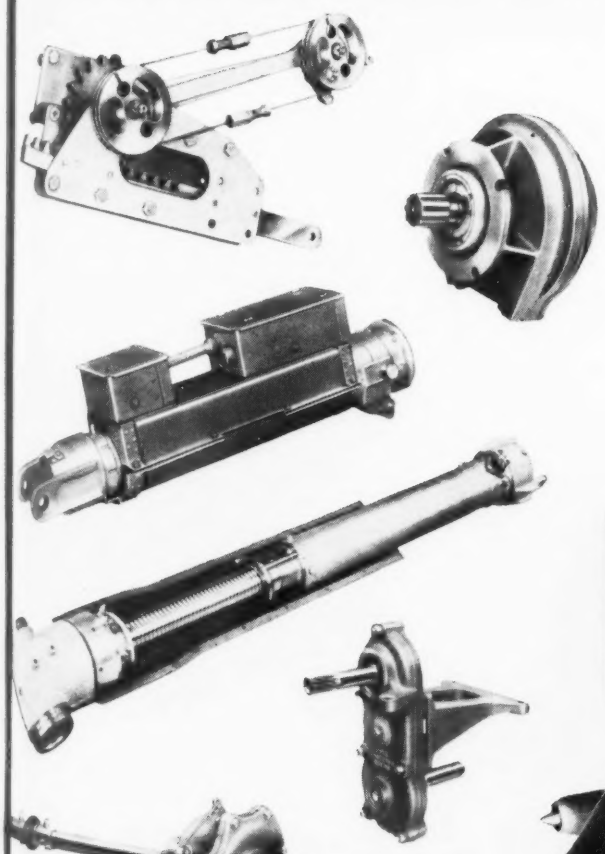
Changes of Address

Since the Post Office Department does not as a rule forward magazines to forwarding addresses, it is important that the Institute be notified of changes in address 30 days in advance of publishing date to ensure receipt of every issue of the *Journal* and *Review*.

Notices should be printed legibly and sent directly to the Institute of the Aeronautical Sciences, Inc., 2 East 64th Street, New York 21, N.Y.

on the B-47

CONTROLS MANUFACTURED BY FOOTE BROS.



It takes more than a joy stick and the seat of your pants to fly a modern jet bomber. Here are some of the control mechanisms designed by Boeing Engineers and manufactured by Foote Bros., installed on the Boeing B-47. These mechanisms must be rugged in strength—able to stand excessive loads. They must operate with hair-trigger precision. They must fit a confined space envelope, and yet must be light in weight. It is the ability of this company to satisfy these exacting demands that has won Foote Bros. Gears and Mechanisms a place on so many of the nation's aircraft and aircraft engines.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. G, 4545 S. Western Blvd. • Chicago 9, Illinois

FOOTE BROS.
Better Power Transmission Through Better Gears

STANDARDS ENGINEERS

A Future is Offered

in

AIRCRAFT GAS TURBINES

at

GENERAL ELECTRIC

Lockland, Ohio

Immediate openings for

Standards Engineers

Engineers to establish and control design standards for aircraft gas turbines. This group collects, interprets, issues design data information and recommended practices for the design engineer. Many interesting contacts with industry and government agencies.

At least a B.S. degree in engineering is required. Applicants must be citizens of the United States.

We Bring the Following Advantages to Your Attention:

. . . Not just a transient wartime industry, but an opportunity for tremendous peacetime expansion in a new, challenging field.

. . . Active, free advanced company engineering training courses.

. . . New modern community. Convenient to modern plant. Ample housing facilities.

. . . Lockland, Ohio, on the outskirts of Cincinnati, the Queen City of America. Social and Civic participation.

. . . Pension, health, and life insurance plans. Company stock bonus plan.

Please send resume to:

Technical & Supervisory Personnel
Aircraft Gas Turbine Department
General Electric Company
Lockland, Ohio

ENGINEERS
DESIGNERS
PHYSICISTS

The Aerophysics & Atomic Energy Research Division of North American Aviation, Inc., offers unparalleled opportunities in Research, Development, Design and Test work in the fields of Long Range Guided Missiles, Automatic Flight and Fire Control Equipment and Atomic Energy. Well-qualified engineers, designers and physicists urgently needed for all phases of work in

Supersonic Aerodynamics
Preliminary Design & Analysis
Electronics
Electro-Mechanical Devices
Instrumentation
Flight Test
Navigation Equipment
Controls
Servos
Rocket Motors
Propulsion Systems
Thermodynamics
Airframe Design
Stress & Structures

●

Salaries Commensurate with training & experience.
Excellent working conditions.
Finest facilities and equipment.
Outstanding opportunities for advancement.

Write now—Give complete resume of education, background and experience.

●

PERSONNEL DEPT.
Aerophysics & Atomic Energy
RESEARCH DIVISION
North American Aviation
INC.
12214 LAKEWOOD BLVD.
DOWNEY, CALIFORNIA

Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to Aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

Wanted

Weight Engineer—Applicant must have a thorough knowledge of weight investigation work, including the calculation of complicated aircraft fittings, preparation of aircraft weight studies, and a thorough knowledge of aircraft balance computations, flight ballasting schedules, and normal weight control procedures from the time of conception of design to actual manufacture of prototype and production articles. Several years' actual experience as a weight engineer is required. Submit reply to Personnel Department, Sikorsky Aircraft, Bridgeport, Conn.

Structural Engineer—Having a minimum of 3 to 4 years of extensive aircraft (preferably including some helicopter background) stress analysis experience, preparing stress data in accordance with Air Force, Navy, and C.A.A. specifications requirements. Those having supervisory experience in directing structural designers and draftsmen given special consideration. Only applicants having practical knowledge of formal stress analysis procedures are asked to apply. Submission of personal data should include comprehensive descriptions of previous positions, salary, scope of assignments, and chief interest in aeronautical engineering field. Submit reply to Personnel Department, Sikorsky Aircraft, Bridgeport, Conn.

Structures Engineer—With 2 or 3 years' aircraft experience needed by small expanding company for essential military airplane projects. Must be familiar with loads, methods of analysis, and allowables. Please submit full details, including education, experience, capabilities, availability, salary requirements, etc. Address: Engineering Department, Anderson, Greenwood & Company, Municipal Airport, Houston 17, Tex.

ENGINEERS—The U.S. Naval Air Rocket Test Station has several vacancies in the Engineering Department. **Aeronautical Engineer**—GS-11, $5,400 per annum. Duties: Project Engineer in the Evaluation Branch, Power Plants Division of the Engineering Department. Conduct specialized investigations, usually extensive in nature of the performance of liquid propellant rocket engines, rocket power plants, and their components. Devise special test procedures, make theoretical analyses, supervise the preparation of the test apparatus and the test operation, and prepare evaluation reports on rocket engines or components. **General Engineer**—GS-11, $5,400 per annum. Duties: Head of Facilities Branch, Power Plants Division, Engineering Department. The Facilities Branch makes plans, procures and installs equipment for new testing facilities and for modifications of existing facilities. The work covers all phases from initial planning and layout to actual installations. **Aeronautical Engineer**—GS-9, $4,600 per annum. Duties: Project Engineer in the Evaluation Branch, Power Plants Division of the Engineering Department. Conducts specialized investigations of the performance of liquid propellant rocket engines, rocket power plants, and their components. Devise special test procedures, make theoretical analyses, and prepare evaluation reports on rocket engines or components. **General Engineer**—GS-9, $4,600 per annum. Duties: Project Engineer in the Facilities Branch, Engineering Department. The Facilities Branch makes plans, procures and installs equipment for new test testing facilities. The work covers all phases from initial planning and layout to actual installation. **Illustrator (equipment)**—GS-6, $3,450 per annum. Duties: Illustrator in the Drafting Section of the Engineering Department. Makes original illustrations of mechanical equipment and lays out technical reports and prepares them for publication. Applicants should submit Standard Form 57, Application for Federal Employment, which is available at any Post Office, and forward to the Industrial Relations Officer, Industrial Relations Department, U.S. Naval Air Rocket Test Station, Lake Denmark, Dover, N.J.

Electronics Instrumentation Engineer—B.E.E. or B. Physics degree required with additional graduate work preferred. Minimum of 5 years of experience. This is a permanent position in charge of an electronics laboratory associated with an aeronautical laboratory. There also are some openings for electrical engineers with less experience. Salary is commensurate with experience. Graduate privileges are available. Liberal employee benefits. Housing not a pressing problem. Send letters of application to: University of Minnesota, Department of Aeronautical Engineering, Rosemount Research Laboratories, Rosemount, Minn.

Flutter Engineer—Permanent position for experimental and theoretical research in flutter, vibration, aeroelasticity, and dynamic loading. Two to 5 years' experience required. Salary commensurate with ability. Unique opportunity to join rapidly developing research organization located on the beautiful Essar Ranch. Address replies to: C. D. Pengelley, Chairman, Engineering Mechanics Department, Southwest Research Institute, P.O. Box 2296, San Antonio, Tex.

Process-Standard Unit Chief—Opening for experienced man to supervise the operations of a unit involved in production and research in the Boeing B-47 jet bomber program for the Air Force. This includes work in the fields of standards, chemical, metallurgical, and mechanical processes; plastics, adhesives and sealers; and drafting procedures. Must be engineering graduate, preferably in chemistry, metallurgy, or aeronautics, with a minimum of 10 years' experience in this field, of which at least 5 years must be in the aircraft industry. Must have had supervisory experience. Write for application blank or submit personal history including education, work experience, and references to our Administrative Engineer. Boeing Airplane Company, Wichita, Kans.

Aerodynamics Master Engineer—T.W.A. has an immediate opening for a master engineer having a rich, practical, and theoretical background in aerodynamics. Desire candidate with 2 to 3 years of actual manufacturing or air-line experience, with background in jet propulsion and related aerodynamics problems. Starting salary $5,790 plus free passes and other desirable employee benefits. Write full qualifications to: Wilbur L. Stone, Employment Manager, Trans World Airlines, 10 Richards Road, Kansas City 6, Mo.

The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

When you write to manufacturers whose advertising appears in the **Aeronautical Engineering Review,** it will be of interest to the companies and of benefit to the Institute if you mention that you saw it in the **Aeronautical Engineering Review**

AEROJET ENGINEERING CORPORATION
WORLD'S LARGEST ROCKET PLANT
NEEDS

Mechanical, Chemical, Aeronautical, Electronic and Electrical Engineers for research, design, and development work on rockets, rocket components, and guided missiles.

Give experience, education, age, work references, personal history, salary received and salary expected.

All inquiries will be considered promptly and kept confidential.

AEROJET ENGINEERING CORPORATION
P. O. Box 296, Azusa, California

McDONNELL AIRCRAFT CORPORATION has openings for the following positions:

PROJECT AERODYNAMICIST—HELICOPTER. Six years of aerodynamics experience required, including a minimum of three years in helicopter aerodynamics for work on long range development of high performance transports, liaison helicopters, cargo unloaders, and convertiplanes.

SENIOR AERODYNAMICISTS—HELICOPTER. Four years of aerodynamics experience required, including a minimum of two years in helicopter aerodynamics, for work on long range development of high performance transports, liaison helicopters, cargo unloaders, and convertiplanes.

AERODYNAMICISTS—AIRPLANE. Two years of aerodynamics experience required in either subsonic, transonic, or supersonic aerodynamics for work on high performance military airplanes.

STRUCTURES ENGINEERS—AIRPLANE. Two years or more of experience required in either stress analysis, air loads, or physical testing for work on high performance military airplanes.

FLUTTER AND VIBRATION SPECIALISTS—MISSILES. Two years or more of experience in the techniques of conventional flutter and vibrations analysis and interested in investigations concerned with the interaction between aeroelastic effects and guidance and control equipment for missiles.

DYNAMICISTS—MISSILES. Openings are available for young men interested in the analytical work and REAC work associated with the analysis and synthesis of complex loop control systems, with airframe dynamics, flutter and vibration and with stability analysis of power control actuators. Requirements for job are an engineering or physics degree, a desire to do theoretical and analytical work, and an above-average proficiency in mathematics and mechanics.

DESIGN ENGINEERS—AIRPLANE AND MISSILES. Two to five years of aircraft or missile design experience in airframe structure, equipment installation, component mechanisms, or power plant installations.

Those persons possessing the qualifications listed above and who are interested in associating with a young progressive company are invited to contact the Technical Placement Supervisor,

MCDONNELL AIRCRAFT CORPORATION

ST. LOUIS 3, MO.

AERODYNAMIC HEATING ENGINEER

Opening exists in Aerodynamic Department for qualified engineer to assume responsibilities for prediction of temperature and heat loads, and evaluation of flight data, for a variety of missiles and aircraft. Must have experience or practical training in this field. Opportunity for work on analysis methods. Excellent salary commensurate with experience and education.

Write: Manager, Engineering Personnel

BELL Aircraft CORPORATION

P.O. BOX 1 BUFFALO 5, N.Y.

Wanted

ENGINEERS AND SCIENTISTS

Unusual opportunities for outstanding and experienced men. These top positions involve preliminary and production design in advanced military aircraft and special weapons, including guided missiles.

Immediate positions include:
Electronic project engineers
Electronic instrumentation engineers
Radar engineers
Flight test engineers
Stress engineers
Aero- and thermodynamicists
Servo-mechanists
Power plant installation designers
Structural designers
Electro-mechanical designers
Electrical installation designers

Excellent location in Southern California. Generous allowance for travel expenses.

Write today for complete information on these essential, long-term positions. Please include resume of your experience & training. Address inquiry to Director of Engineering,

NORTHROP AIRCRAFT, Inc.
1005 E. Broadway
Hawthorne (Los Angeles County), Calif.

RESEARCH OPPORTUNITIES

Openings in the field of design of electronic equipment are available to MATHEMATICIANS, PHYSICISTS, and ENGINEERS at the University of Michigan's Willow Run Research Center.

PHYSICISTS and MATHEMATICIANS—with Bachelor's or Master's degrees, should also have a working knowledge of, and some experience in, electronics. Ph.D's with electronics experience are especially desired.

ENGINEERS—with experience in circuit development and design on analog or digital computers, telephone switching equipment or cathode ray displays are especially desired.

Researchers are offered the opportunity to complete the requirements for graduate degrees while employed at the Research Center.

Salaries are commensurate with training and experience. Applicants are invited to send a resume of education and experience to:

Personnel Office
University of Michigan
Ann Arbor, Michigan

350. Instructor or Assistant Professor—An opening is available immediately for Instructor or Assistant Professor to teach either aerodynamics or structures courses at a leading engineering college in the East. Salary and rank commensurate with experience and background. Some industry experience and advanced degree desired.

Available

356. Engineering Supervisor—Age 31. Eleven years' experience in aircraft manufacture, air-lines and military aircraft repair bases, covering all types of aircraft. Desires position with future in air-line organization or airplane repair and maintenance center.

354. Aeronautical Engineer—Professor. B.S., M.S., A.F.I.A.S. Presently employed as Chief Engineer of military test development and instructional division as aeronautical consultant and as visiting graduate school professor at a large eastern university. Desires full time research and development, industrial, or teaching work. Over 10 years of aeronautical engineering experience in industry and in teaching. Author of two recent textbooks on aerodynamics, as well as technical papers on stress analysis and aerodynamics which have appeared in the *Journal of The Aeronautics Sciences* and *Aero Digest*. Please advise as to the nature of openings in first letter. Routine or form inquiries will not be considered.

353. Mechanical and Aeronautical Engineer—B.S., M.E. Available for consultation. Experience includes: design and development of variety of automotive devices; patent analysis and patent expert in important litigation; design, development, and test supervision of well-known helicopter; study and design of convertoplane; origination and development of intricate ordnance mechanisms.

352. Aeronautical Engineering Professor-Development Engineer (M.S.)—Extensive and varied aeronautical background (both administrative and technical) in fixed and rotating wing aircraft. Graduate and undergraduate teaching experience in aerodynamics (classical and supersonic), design, and structures. Many aeronautical publications including textbook. Will consider research and administrative possibilities.

351. Aeronautical Engineer—Age 33. Two years' postwar light aircraft and accessory sales experience. Four years' service in Army Air Forces. Air Transport Command Dispatcher. Two years' Army Air Forces Intelligence in Air Materiel Command. Graduate 1st A.A.F. Helicopter Maintenance Engineering training unit. One year of aeronautical drafting, 6 months' air-line experience.

349. Technical Training Administrator—Ten years of experience in administration technical training schools, including personnel, equipment, and outlines of instruction. Have also had extensive "on-the-job training" experience. Age 41. Further details on request.

348. Development Engineer—M.S. and B.S. in M.E., Massachusetts Institute of Technology. Analytical background in advanced hydrodynamics, gas dynamics, heat transfer, gas-turbine problems. Five years' experience in liquid propellant rocket power-plant development and testing. Supervisory status in this and other jet propulsion research. Age 32.

347. Aeronautical Draftsman—B.Sc., B.E., Cert. in Aero. Drafting and Engineering. Desires position as draftsman, layout, design, or detail; experience includes 10 years as Engineering Draftsman, 5 years as Drafting Instructor. Foreign citizen, but would undergo any security investigation in order to obtain clearance. Location preferred: eastern states.

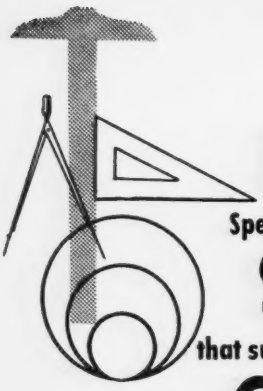
American Delegates to the Third Anglo-American Aeronautical Conference

(*Continued from page 34*)

Ernest G. Stout, Assistant to the Chief Engineer, Consolidated Vultee Aircraft Corporation
Michael Stroukoff, President and Chief Engineer, Chase Aircraft Company, Inc.
Philip B. Taylor, Partner, Sanderson & Porter
Th. Theodorsen, Consultant, Office of Air Research, U.S.A.F.
E. S. Thompson, Manager of Sales, Aircraft Gas Turbine Division, General Electric Company
J. Parker Van Zandt, Office of the Secretary, Deputy Assistant, U.S.A.F.
T. F. Walkowicz, Lt. Colonel, U.S.A.F., Executive Office, Special Assistant to Chief of Staff
Lee S. Wasserman, Acting Chief, Aerodynamics Group, O.A.R.
Frank L. Wattendorf, Deputy Scientific Adviser, Air Engineering Development Division
Jack W. Wood, Brig. General, Air Attaché, Embassy of the United States of America
Lysle A. Wood, Chief Engineer, Boeing Airplane Company
R. J. Woods, Chief Design Engineer, Bell Aircraft Corporation
G. E. Woods-Humphery, President, Flight Refueling, Inc.
Harper Woodward, Aviation Adviser to Laurance Rockefeller
T. P. Wright, Acting President, Cornell University
Raymond W. Young, President and General Manager, Reaction Motors, Inc.
Stephen J. Z and, Vice-President in Charge of Engineering, Lord Manufacturing Company

Wives and Guests of American Delegates

Mrs. George Brady
Mrs. John W. Crowley
Mrs. Ivan H. Driggs
Mrs. Louis G. Dunn
Mrs. Herman H. Ellerbrock
Mrs. Allan D. Emil
Mrs. Frank W. Fink
Mrs. A. H. Flax
Mrs. Wendell S. Fletcher
Mrs. John F. Floberg
Mrs. I. E. Garrick
Mrs. D. Gerdan and Daughter
Miss Edith Gray
Mrs. Leroy R. Grumman
Mrs. Nicholas J. Hoff
Mrs. John J. Ide
Mrs. S. Paul Johnston
Mrs. J. W. Larson
Mrs. Fred P. Laudan and Son
Mrs. Robert T. Leadbetter
Mrs. Jerome Lederer
Mrs. Carl W. Lemmerman
Mrs. Robert J. Mason
Mrs. Abbie C. Milliken
Mrs. Glenn Murphy
Mrs. John W. Myers
Mrs. Carroll Peirce and Child
Mrs. Courtland Perkins
Mrs. A. E. Raymond
Mrs. L. B. Richardson
Mrs. Laurance S. Rockefeller
Mrs. W. C. Rockefeller
Mrs. George S. Schairer
Mrs. Edward R. Sharp
Mrs. D. Roy Shoults
Mrs. Ferris M. Smith
Mrs. Kenneth C. Spengler
Mrs. Jackson R. Stalder
Mrs. George Starbird
Michael Stoukoff, Jr.
Mrs. Ernest G. Stout and Daughters
Mrs. Philip B. Taylor
Mrs. Lysle A. Wood
Mrs. G. E. Woods-Humphery
Mrs. T. P. Wright
Mrs. Raymond W. Young and Son



ENGINEERS

Special opportunities for YOU in

SAN DIEGO

that sunshiny, smog-free city on the coast of

CALIFORNIA

Convair (Consolidated Vultee Aircraft Corporation) is now accepting applications for these following positions in its modern, progressive Engineering Department.

Design Engineers	**Weight Engineers**
Design Draftsmen	**Aerodynamics Engineers**
Electrical Draftsmen	**Test Engineers**
Electronics Engineers	**Thermodynamics Engineers**
Microwave Engineers	**Aircraft Linesmen**
Servo Engineers	
Aircraft Loftsmen	

WORKING FACTS: You get two holidays a week at Convair — overtime accomplished in 5-day week. Attractive salary ranges. An "engineers" engineering department . . . with stimulating, competent associates . . . and interesting, challenging, essential, long-range projects of a wide variety including — commercial aircraft, military aircraft, missiles, engineering research and electronic development. Excellent patent royalty arrangements. Top-notch retirement plan — better than-average life and health insurance. Complete progress-salary review for each person twice yearly. Opportunity for continuing engineering education.

LIVING FACTS: San Diego, with its wonderful residential areas, offers you and your family incomparable living. Ideal climate — cool, clean, dry. Mountains, desert, Mexico, Hollywood, Los Angeles, Pacific Ocean, beaches and bay — only hours or minutes away. It offers you a new way of Life... pleasant, refreshing, happy.

If you qualify, you will receive generous travel allowances.
***SEND COUPON* for free booklets and complete information.**

THANK YOU

Mr. H. T. Brooks, *Engineering Department 300*
***Convair,* 3302 Pacific Hiway, San Diego, California**

Please send me ***FREE*** booklets describing the Convair Opportunity for me and my Convair Application Form.

My name_____

Occupation _____

Address_____

City_____ State_____

ATOMIC WEAPONS INSTALLATION

NEEDS

MECHANICAL ENGINEERS

Two to ten years' experience in research, design, development or test. A variety of positions open for men, with Bachelor's or advanced degree, qualified in one or more of the following:

- **MECHANISMS**
- **STRESS ANALYSIS**
- **QUALITY CONTROL**
- **INSTRUMENTATION**
- **SHOCK AND VIBRATION**
- **HANDLING EQUIPMENT**
- **ENVIRONMENTAL TESTING**
- **ELECTRONIC PACKAGING**

Patent History Desirable But Not Necessary.

STANDARDS ENGINEERS

Experienced in writing specifications, in liaison work and in correlating design information to accepted standards. Aircraft industry experience desirable.

PHYSICISTS

With background of pure physics.

TECHNICAL WRITERS

Experienced in preparation and publication of standards, electronic and mechanical technical manuals. Engineering background necessary.

JOB ANALYSTS

Mechanical and electrical engineers experienced in job evaluation and other wage administration activities.

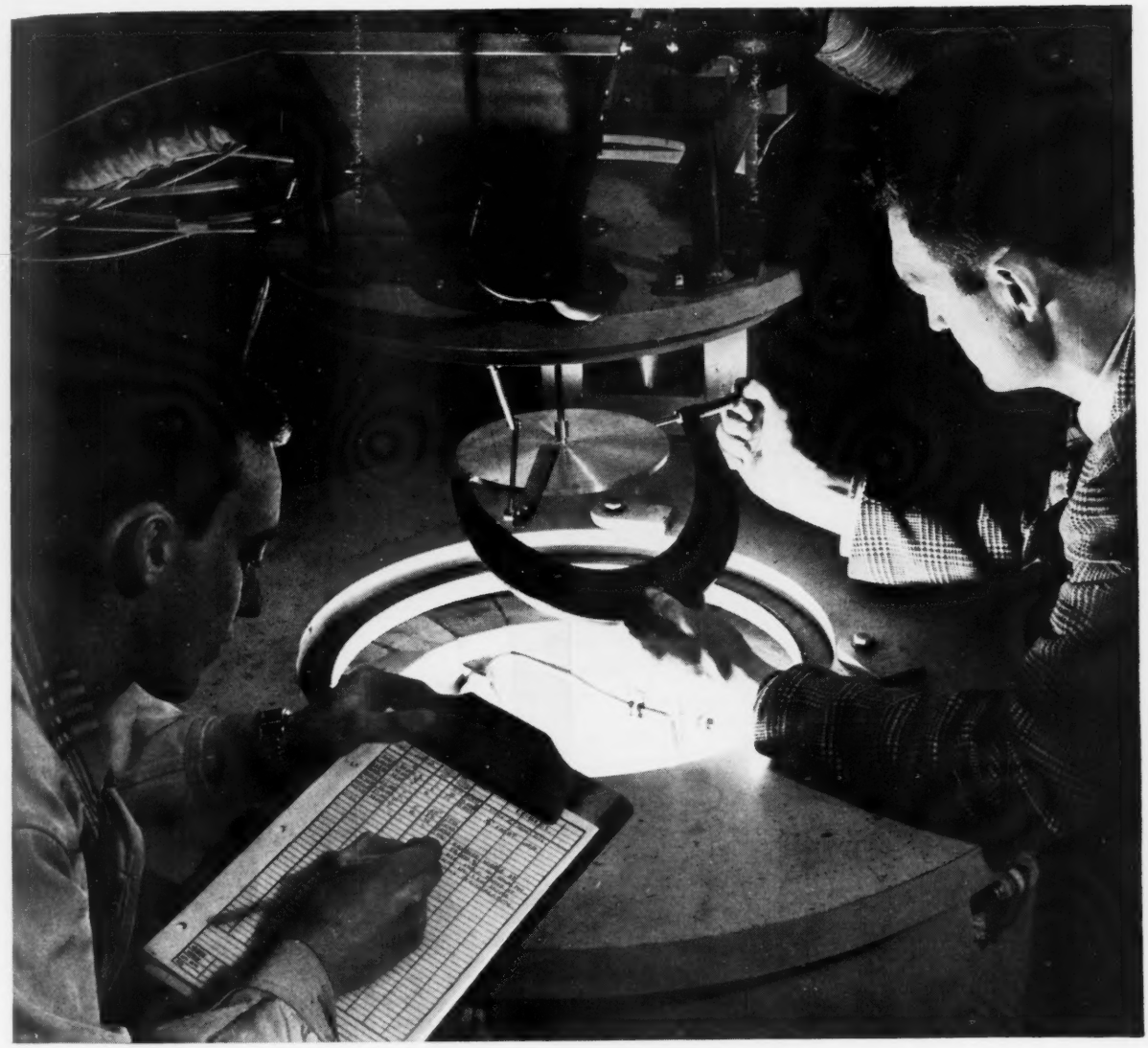
THESE ARE PERMANENT POSITIONS with Sandia Corporation in Albuquerque, N. M. The Laboratory is operated by Sandia Corporation, a subsidiary of the Western Electric Company, under contract with the ATOMIC ENERGY COMMISSION. This laboratory offers good working conditions and liberal employee benefits, including paid vacations, sick leave, and a retirement plan.

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment," Albuquerque lies at the foot of the Sandia Mountains, which rise to 11,000 feet. Climate is sunny, mild and dry the year 'round. NO HOUSING SHORTAGE in the Albuquerque area.

PROFESSIONAL EMPLOYMENT DIVISION

SANDIA CORPORATION

SANDIA BASE
ALBUQUERQUE, NEW MEXICO



Do you want a career with a future?

More and more of America's outstanding engineers are carving fine careers for themselves at Boeing. They've found a future here in an Engineering Division that's been growing steadily for over 35 years.

If you measure up, there's great opportunity here for you, too, and the rewarding experience of working on some of the nation's most vital programs such as the B-52 and B-47 jet bombers, guided missiles and other revolutionary developments.

You'll associate with men of the highest engineering renown, men who can help you further your own professional standing. You'll find here research facilities that are among the world's finest. And you'll enjoy a good salary that grows with you.

Needed now in Seattle are experienced and junior aeronautical, mechanical, electrical, electronics, civil, acoustical, weights and tooling engineers for design and research; servo-mechanism designers and analysts; and physicists and mathematicians with advanced degrees. *(More housing is available in Seattle than in most other major industrial centers.)*

Or, if you prefer the Midwest, similar openings are available at the Boeing Wichita, Kansas, Plant. Inquiries indicating such a preference will be referred to the Wichita Division.

Write today to the address below or use the convenient coupon.

JOHN C. SANDERS, Staff Engineer—Personnel
Dept. W-12
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

Address _____

City and State _____

BOEING

ENGINEERS

WANTED AT ONCE

For

LONG - RANGE MILITARY AIRCRAFT PROGRAM

by

NORTH AMERICAN AVIATION, INC.

Los Angeles, California

Columbus, Ohio

Unusual opportunities for Aerodynamicists, Stress Engineers, Aircraft Designers and Draftsmen, and specialists in all phases of aircraft engineering. Engineering skills other than aircraft may be adaptable through paid training program. Also openings for

Recent Engineering College and Techological Graduates

Long-range military program offers fine chance for establishing career in aircraft while aiding defense effort. Transportation to California and established training time paid. Salaries commensurate with experience and ability.

Please include summary of education and experience in reply to:

Engineering Personnel Office

Section 2

NORTH AMERICAN AVIATION, INC.

Los Angeles International Airport

Los Angeles 45, Calif.

or

Columbus 16, Ohio

California Calling

ENGINEERS

A better job, a better life, a better future can be yours in California—at Lockheed Aircraft Corporation.

On the job, you enjoy increased pay; fine, modern working conditions; association with top men in your profession—men who have helped build Lockheed's reputation for leadership.

Off the job, you live in a climate beyond compare—where outdoor living can be enjoyed the year around.

In addition, Lockheed's production rate and backlog of orders—for commercial as well as military aircraft insures your future.

POSITIONS NOW OPEN INCLUDE:

Aerodynamicists
Aerodynamics Engineers
Airplane Specifications Engineers
Design Engineers Drawing Checkers
Engineering Technical Writers
Flight Manuals Engineers
Machine and Equipment Design Engineers
Manufacturing Engineers
Production Design Engineers
Stress Engineers and Analysts
Tool Standards Engineers
Weight Engineers
Recent Engineering Graduates

NOTE TO ENGINEERS WITH FAMILIES:

Housing conditions are excellent in the Los Angeles area. More than 35,000 rental units are available. Thousands of homes have been built since the war; huge tracts are under construction now. You will find the school system as good—from kindergarten to college.

Send today for free, illustrated brochure describing life and work at Lockheed in Southern California. Use handy coupon below.

Mr. M. V. Mattson, Employment Manager Dept. AR-12

LOCKHEED

AIRCRAFT CORPORATION, Burbank, California

Dear Sir: Please send me your brochure describing life and work at Lockheed.

My name _____

My address _____

My city and state _____

My occupation (type of engineer) _____

FIRSTS

BY BELL AIRCRAFT

- FIRST — Supersonic Aircraft (X-1)
- FIRST — Aircraft to Vary Wing Sweepback in Flight (X-5)
- FIRST — Jet-Propelled Fighter in U. S. (F-59)
- FIRST — Commercially Licensed Helicopter

BELL AIRCRAFT CORPORATION

NEEDS

SCIENTISTS! ENGINEERS! DESIGNERS! DRAFTSMEN!

to accept the challenge of development work in . . .

LONG RANGE PROGRAMS

on

GUIDED MISSILES

AIR-BORNE ELECTRONIC EQUIP'T

ROCKET ENGINES

HELICOPTERS

CONVERTIPLANES

Scientific or engineering degree and extensive technical experience required.

INQUIRE NOW!

Manager, Engineering Personnel

BELL *Aircraft* CORPORATION

P.O. BOX 1 BUFFALO 5, N.Y.

Index to the

Aeronautical Engineering Review, Volume 10

January—December, 1951

	Month	Page
Adhesives, sealers, and coatings, aircraft	*Aug.*	10
Aerodynamics—		
Aerodynamic Aspects of the Third International Aeronautical Conference, A. H. Flax	*Dec.*	35
Aerodynamic Forces Associated with Inlets of Turbojet Installations, De Marquis D. Wyatt	*Oct.*	20
Some Observations on Aeronautical Research in England with Particular Reference to Stability and Control, William F. Milliken, Jr.	*Dec.*	45
Aeroelasticity—		
Investigation of Flight-Flutter Testing Techniques, Martin D. Schwartz and Donald L. Wrisley	*Aug.*	24
AG-14 pusher, power-plant installation of the	*Feb.*	31
Air traffic control	*May*	18
Air Transport—		
Future Air Transport Possibilities, Grover Loening	*Aug.*	17
Review of Papers on Air Transport, R. W. Rummel	*Dec.*	40
Some Special Aspects of Air Transport Safety, C. M. Christenson	*July*	23
All-weather flying	*May*	44
American Helicopter Society—		
Activities and Events	*Feb.*	10
1951 A.H.S. Forum	*July*	7
July Dinner Meeting of Mid-Eastern Region	*Oct.*	38
News	*Aug.* 46, *Sept.*	6
Western Regional Dinner Meeting	*June*	44
ANDERSON, BEN, AND MARVIN GREENWOOD. Power-Plant Installation of the AG-14 Pusher	*Feb.*	31
Antenna problems, air-borne	*May*	32
Automatic Control—		
Analysis of Systems for Automatic Control of Aircraft, James B. Rea	*Nov.*	39
Autopilot Flight Tests on the Constellation, R. L. Thoren and W. L. Howland	*Nov.*	31
Control-Surface Position Feedback in Flight-Control Systems, Leonard Becker	*Sept.*	17
A Design Method for Automatic Longitudinal Control Systems, Frederick Stevens and K. Martin Stevenson	*Jan.*	18
A Tested Solution of the Problem of Helicopter Stability and Automatic Control, Donald N. Meyers, Edward G. Vanderlip, and P. Halpert	*July*	27
AUYER, E. L., AND R. T. HOLLAND. Practical Aspects of Turbojets in Transport Aircraft	*Mar.*	32
BANKS, CHARLES R. Problems of Standardizing Electronic Equipment for Aircraft	*May*	24
Beam-columns, continuous, interaction curves for the critical loads on	*Mar.*	40
BECKER, LEONARD. Control-Surface Position Feedback in Flight-Control Systems	*Sept.*	17
BERTRANDIAS, MAJOR GEN V. E. Flight Safety Research	*Apr.*	31
BURGESS, N., AND E. S. THOMPSON. Comparisons of British and American Gas-Turbine Practice	*Dec.*	47
Ceramics and special alloys—a metallurgical investigation at elevated temperatures	*Nov.*	24
CHRISTENSEN, I. G. Aircraft Adhesives, Sealers, and Coatings	*Aug.*	10
CHRISTENSON, C. M. Some Special Aspects of Air Transport Safety	*July*	23
Cockpit check lists, placards, and manuals, considerations in the design and installation of	*Sept.*	10
Colorado University's steam-jet-powered supersonic wind tunnel	*Mar.*	38
Constellation, autopilot flight tests on the	*Nov.*	31
Control-surface position feedback in flight-control systems	*Sept.*	17
Cooling a turbojet installation, ejectors for	*Sept.*	20
Design—		
Application of Rocket Power to Aircraft, Howard R. Moles	*Apr.*	24
Considerations in the Design and Installation of Cockpit Check Lists, Placards, and Manuals, David H. Kaplan	*Sept.*	10
The Engineering Approach—1903–1973, Grover Loening	*Mar.*	36
General Aspects of Cabin Pressurization, R. W. Rummel	*July*	14
Review of Papers on Air Transport, R. W. Rummel	*Dec.*	40
Distance-measuring equipment for the terminal area	*May*	48
Documentation—		
Service for Contractors, Maurice H. Smith	*Apr.*	12
DUNNING, ORVILLE M. Packaging of Air-Borne Electronic Equipment	*May*	29
Editorials—		
AMC—The Biggest Business in the World, Lt. Gen. B. W. Chidlaw	*Oct.*	10
Electronics in Aviation, Captain S. B. Spangler, U.S.N.	*May*	8
Fait Accompli	*Nov.*	22

	Month	Page
First Things First	*Apr.*	22
Life Begins at Sixty-Five—, Dr. Nathan A. Bowers	*June*	8
A Message from Britain, Lord Brabazon of Tara	*Dec.*	22
Presidential Shift	*Feb.*	19
The Question of Security	*Sept.*	8
Technical Progress and Air Power in the World Crisis, Rear Adm. L. B. Richardson	*July*	10
Third International	*Aug.*	8
Youth Must Be Served, Rear Adm. A. M. Pride	*Jan.*	16
Visitor of the Week	*Mar.*	29
Ejectors for cooling a turbojet installation	*Sept.*	20
Electronics—		
Air-Borne Antenna Problems, Dr. Harald Schutz	*May*	32
Air Traffic Control, The Hon. Delos W. Rentzel	*May*	18
All-Weather Flying, Captain R. C. Robson	*May*	44
Distance-Measuring Equipment for the Terminal Areas, Joseph Lyman and George B. Litchford	*May*	48
Electronics for Aircraft Illustrated, Welman A. Shrader	*May*	12
Electronics in Aviation, Harold A. Kressly and John S. Erickson	*May*	14
Frequency Allocation for Aviation Electronics, Edwin Lee White	*May*	38
Packaging of Air-Borne Electronic Equipment, Orville M. Dunning	*May*	29
Problems of Standardizing Electronic Equipment for Aircraft, Charles R. Banks	*May*	24
Engineering approach—1903–1973	*Mar.*	36
ERICKSON, JOHN S., AND HAROLD A. KRESSLY. Electronics in Aviation	*May*	14
Fatigue problems in transport aircraft	*June*	20
FAUGHT, H. F., AND C. A. MEYER. A Method of Presenting the Performance of Turbojet Engines	*Jan.*	33
FLAX, A. H. Aerodynamic Aspects of the Third International Aeronautical Conference	*Dec.*	35
Flight-flutter testing techniques, investigation of	*Aug.*	24
Flight Propulsion—		
Aerodynamic Forces Associated with Inlets of Turbojet Installations, De Marquis D. Wyatt	*Oct.*	20
Application of Rocket Power to Aircraft, Howard R. Moles	*Apr.*	24
Ceramics and Special Alloys—A Metallurgical Investigation at Elevated Temperatures, Wilson G. Hubbell	*Nov.*	24
Closed-Circuit Oil System for Turbojet and Turboprop Aircraft Engines, P. H. Schweitzer	*June*	16
Comparisons of British and American Gas-Turbine Practice, E. S. Thompson and N. Burgess	*Dec.*	47
Ejectors for Cooling a Turbojet Installation, H. C. Towle and F. V. H. Judd	*Sept.*	20
An Experimental Investigation of Supersonic Lattice Flow, James E. O'Neill	*Jan.*	28
A Method of Presenting the Performance of Turbojet Engines, C. A. Meyer and H. F. Faught	*Jan.*	33
Operational Aspects of Turbo-Jet Transports, R. Dixon Speas	*Nov.*	48
Power-Plant Installation of the AG-14 Pusher, Ben Anderson and Marvin Greenwood	*Feb.*	31
Practical Aspects of Turbojets in Transport Aircraft, R. T. Holland and E. L. Auyer	*Mar.*	32
Flight Safety—		
Considerations in the Design and Installation of Cockpit Check Lists, Placards, and Manuals, David H. Kaplan	*Sept.*	10
Flight Safety Research, Major Gen. V. E. Bertrandias	*Apr.*	31
Some Special Aspects of Air Transport Safety, C. M. Christenson	*July*	23
FUSFELD, ROBERT D. A Method of Calculating the Landing Flare Path of an Airplane	*Feb.*	25
GREENWOOD, MARVIN, AND BEN ANDERSON. Power-Plant Installation of the AG-14 Pusher	*Feb.*	31
Guided Missiles—		
Pilotless Aircraft Research at N.A.C.A.'s Pilotless Aircraft Research Station, Wallops Island, Va., Welman A. Shrader	*Oct.*	24
The Upper Atmosphere—Its Exploration and Exploitation, Willy Ley	*Feb.*	20
GUSTAFSON, F. B. Desirable Longitudinal Flying Qualities for Helicopters and Means To Achieve Them	*June*	27
HAGE, ROBERT E. Variation in Airplane Range with Wind Velocity	*July*	18
HALPERT, P., DONALD N. MEYERS, AND EDWARD G. VANDERLIP. A Tested Solution of the Problem of Helicopter Stability and Automatic Control	*July*	27
HARRISON, HENRY T. Some Meteorological Problems Indicated for Jet Transport Operation at 40,000 Ft	*Apr.*	52
Helicopters—		
Desirable Longitudinal Flying Qualities for Helicopters and Means To Achieve Them, F. B. Gustafson	*June*	27
Helicopters—Present and Future, Igor I. Sikorsky	*Feb.*	37
An Investigation of a Rotor Blade Thermal Ice-Prevention System for the H-5 Helicopter, E. F. Katzenberger	*Sept.*	25
A Tested Solution of the Problem of Helicopter Stability and Automatic Control, Donald N. Meyers, Edward G. Vanderlip, and P. Halpert	*July*	27
HOFF, NICHOLAS J. A Report on the First U.S. National Congress of Applied Mechanics	*Oct.*	30
———. A Review of Papers on Structures and Materials	*Dec.*	42
HOLLAND, R. T., AND E. L. AUYER. Practical Aspects of Turbojets in Transport Aircraft	*Mar.*	32
HOWLAND, W. L., AND R. L. THOREN. Autopilot Flight Tests on the Constellation	*Nov.*	31
HUBBELL, WILSON G. Ceramics and Special Alloys—A Metallurgical Investigation at Elevated Temperatures	*Nov.*	24
Hydrodynamic notes on the Third International Aeronautical Conference	*Dec.*	49
Ice-prevention system, rotor blade thermal, for the H-5 helicopter, an investigation of	*Sept.*	25
Inlets of turbojet installations, aerodynamic forces associated with	*Oct.*	20
Institute of the Aeronautical Sciences—		
A.A.A.S. Holds Annual Science Exposition and Conference on Scientific Manpower	*Dec.*	21
Aeronautical Engineering Catalog Available	*June*	6
Aeronautical Fellowships Awarded	*Oct.*	6

	Month	Page
A.I.A.A. Elects I.A.S. Members to Posts	*Feb.*	12
American Helicopter Joins I.A.S.	*June*	6
Annual Business Meeting of the Institute	*Mar.*	13
Annual Summer Meeting Preliminary Announcement	*May*	5
1951 Annual Summer Meeting Report	*Sept.*	5
A.S.M.E. Holds Aeronautical Meeting	*June*	38
A.T.A. Elects Directors; Admiral Land Plans To Resign	*Mar.*	20
Bane and Chanute Awards Presented	*Aug.*	5
A Brief Report on the Fourteenth Wright Brothers Lecture	*Mar.*	19
British Scientist To Present Fifteenth Wright Brothers Lecture	*Oct.*	5
W. A. M. Burden Adds to Library Gift	*Mar.*	21
Cargo Carrier Concern Joins I.A.S.	*July*	8
Case Institute Expands Engineering Program	*July*	9
Commanding General, A.M.C., To Be Principal Speaker at Summer Meeting Dinner	*June*	5
Danger of Skidding Removed from Landings	*May*	7
Daniel Guggenheim Park Sold	*Nov.*	19
R. W. Darrow Selected for Award	*Mar.*	20
Director's Report	*Mar.*	14
Flight Refueling, Inc., Joins I.A.S.	*May*	6
Fluid Mechanics Conference Set	*Oct.*	6
Fourth Symposium on Applied Mathematics	*Sept.*	6
G-E Aircraft Gas Turbine Laboratory Dedicated	*Feb.*	6
Gifts to the Institute Collections	*Apr.*	7
The Robert H. Goddard Memorial Exhibit	*Feb.*	8
Greater New York Safety Convention and Exposition	*Dec.*	21
1951 Guggenheim Jet Propulsion Fellows Named	*Aug.*	6
1950 Guggenheim Medal Presented to Dr. Dryden	*Mar.*	11
1951 Guggenheim Medalist, Igor I. Sikorsky	*Oct.*	6
Guided-Missile Authority Retires	*Jan.*	8
1951 Heat Transfer and Fluid Mechanics Institute	*Sept.*	7
Highlights of the Technical Sessions of the Nineteenth Annual Meeting	*Jan.*	7
Honors Night Dinner Address, James E. Webb	*Mar.*	30
I.A.S. 20th Annual Meeting	*Dec.*	20
I.A.S. Fellows for 1950	*Mar.*	10
I.A.S. Honors and Awards for 1950	*Mar.*	6
I.A.S. Members Named to Chairmenships of N.A.C.A. Technical Committees	*Apr.*	6
I.A.S. Navy Inspection Tour	*Jan.*	6
I.A.S. Officers for 1951	*Mar.*	12
The I.A.S.-Sponsored Applied Mechanics Reviews	*Nov.*	20
I.A.S. Student Branches Hold Second Annual Southeastern Regional Meeting	*July*	8
I.A.S. To Send Ninety Delegates to Third Anglo-American Aeronautical Conference	*July*	5
I.A.T.A. Delegates Guests of Donald W. Douglas	*Jan.*	8
Impressions of the Third Anglo-American Aeronautical Conference, Welman A. Shrader	*Dec.*	24
1951 International Exhibition	*Jan.*	8
M. W. Kellogg Joins I.A.S.	*Dec.*	21
Lear Wins Collier Trophy	*Feb.*	11
Maddida Displayed During I.A.S. Annual Meeting	*Apr.*	6
March 16 Set As Date for Sixth National Flight Propulsion Meeting	*Feb.*	5
Marquardt Aircraft Company Joins I.A.S.	*Mar.*	20
Medaille de l'Aéronautique Awarded Captain Pritchard	*June*	6
National Conference on Industrial Hydraulics	*Nov.*	20
Newly Elected Members to the Institute Council	*Mar.*	16
Nineteenth Annual Meeting—Impressions and Comments, Dr. Stephen J. Zand	*Apr.*	35
Notes on the Annual Meeting	*Mar.*	5
Office of Air Research Lets Oil-Film Contract	*July*	9
President's Report	*Mar.*	13
Propeller-Blade Extrusion Method Developed	*May*	6
Prototype Aircraft Advisory Committee Established.	*Mar.*	20
A Report on the Sixth National Flight Propulsion Meeting	*June*	7
D. C. Sayre To Head Forrestal Research Center	*Apr.*	7
Service for Contractors, Maurice H. Smith	*Apr.*	12
Space Medicine Society Formed	*Aug.*	7
Square D Company's Kollsman Division Sold; Victor E. Carbonara To Be President	*Feb.*	11
Technical Sessions—Annual Summer Meeting, Harold Luskin	*Oct.*	16
Third Joint R.Ae.S.-I.A.S. International Conference Set for September	*Apr.*	5
Three Student Members Win Contest	*Feb.*	14
Treasurer's Report	*Mar.*	14
University of Wichita Honors Memory of Walter H. Beech	*Oct.*	7
von Kármán Wins British Medal	*Feb.*	11
James E. Webb To Be Speaker at Honors Night Dinner	*Jan.*	5
West Coast I.A.S. Student Branches Hold Regional Meeting	*Aug.*	6
Charles E. Wilson To Be Speaker at Honors Night Dinner	*Dec.*	19

Jet transport operation at 40,000 ft., some meteorological problems indicated for ... *Apr.* 52

JUDD, F. V. H., AND H. C. TOWLE. Ejectors for Cooling a Turbojet Installation ... *Sept.* 20

KAPLAN, DAVID H. Considerations in the Design and Installation of Cockpit Check Lists, Placards and Manuals ... *Sept.* 10

KATZENBERGER, E. F. An Investigation of a Rotor Blade Thermal Ice-Prevention System for the H-5 Helicopter ... *Sept.* 25

KRESSLY, HAROLD A., AND JOHN S. ERICKSON. Electronics in Aviation ... *May* 14

Landing flare path of an airplane, a method of calculating ... *Feb.* 25

LEY, WILLY. The Upper Atmosphere—Its exploration and Exploitation ... *Feb.* 20

LITCHFORD, GEORGE B., AND JOSEPH LYMAN. Distance-Measuring Equipment for the Terminal Area ... *May* 48

LOENING, GROVER. The Engineering Approach—1903–1973 ... *Mar.* 36

———. Future Air Transport Possibilities ... *Aug.* 17

LUSKIN, HAROLD. Technical Sessions—Annual Summer Meeting ... *Oct.* 16

LYMAN, JOSEPH, AND GEORGE B. LITCHFORD. Distance-Measuring Equipment for the Terminal Area ... *May* 48

Materials—

Aircraft Adhesives, Sealers, and Coatings, I. G. Christensen ... *Aug.* 10

	Month	Page
Ceramics and Special Alloys—A Metallurgical Investigation at Elevated Temperatures, Wilson G. Hubbell	*Nov.*	24
Ocean Test Tube, International Nickel Company's Laboratories, Kure Beach and Wrightsville Beach, N.C., Welman A. Shrader	*Jan.*	24
A Review of Papers on Structures and Materials, Nicholas J. Hoff	*Dec.*	42
McCone, John A. The Air Force Procurement and Expansion Program	*June*	12
Mechanics, Applied, a report on the First U.S. National Congress of	*Oct.*	30
Meteorology—		
Some Meteorological Problems Indicated for Jet Transport Operation at 40,000 Ft., Henry T. Harrison	*Apr.*	52
The Upper Atmosphere—Its Exploration and Exploitation, Willy Ley	*Feb.*	20
Meyer, C. A., and H. F. Faught. A Method of Presenting the Performance of Turbojet Engines.	*Jan.*	33
Meyers, Donald N., Edward G. Vanderlip, and P. Halpert. A Tested Solution of the Problem of Helicopter Stability and Automatic Control.	*July*	27
Military Aviation—		
The Air Force Procurement and Expansion Program, John A. McCone	*June*	12
Honors Night Dinner Address, The Hon. James E. Webb	*Mar.*	30
Military Research and Development, Philip B. Taylor	*Apr.*	49
Milliken, William F., Jr. Some Observations on Aeronautical Research in England with Particular Reference to Stability and Control	*Dec.*	45
Moles, Howard R. Application of Rocket Power to Aircraft	*..pr.*	24
Necrology—		
Adams, John S., Jr.	*Jan.*	8
Aument, Carroll M.	*Feb.*	14
Bakhmeteff, Dr. B. A.	*Oct.*	7
Beech, Walter H.	*Feb.*	14
Burgess, Charles P.	*Aug.*	7
Campbell, Horace A.	*July*	38
Christian, Wallace J.	*June*	38
Derwingson, Joseph G.	*Dec.*	60
Dobony, Ensign Charles	*July*	38
Farmer, William G. D.	*Aug.*	42
Friedman, William S.	*Sept.*	7
Graham, William H., Jr.	*May*	7
Gulshen, Ensign Francis J.	*Oct.*	7
Hanley, William V.	*June*	38
Harrigan, William P.	*Feb.*	15
Heimburger, Douglas Corbett	*Nov.*	20
Herman, Fred W.	*June*	38
Holbrook, Charles T.	*Oct.*	7
Huff, Thomas Henri	*Apr.*	7
Kellett, W. Wallace	*Oct.*	36
Lockwood, Preston	*June*	38
Love, Charles C.	*Feb.*	15
McAlpine, Major G.	*Feb.*	15
Meade, Joseph F., Sr.	*Jan.*	8
Ovens, William G.	*June*	40
Pawlowski, F. W.	*June*	40
Pearson, Walter H.	*Aug.*	42
Phillips, James A., Jr.	*Feb.*	15
Powell, Dr. Clarence Henry	*Nov.*	20
Purdon, Lt. Comdr. David	*Mar.*	23
Roy, Capt. Robert R.	*Sept.*	7
Segal, Robert Louis	*Nov.*	21
Sutton, Harry A.	*Sept.*	36
Tuntland, Paul E.	*Apr.*	9
Tuttle, Col. A. D.	*Dec.*	60
Wall, Walter R., Jr.	*Apr.*	9
Wallace, Lee S.	*June*	40
Ware, Raymond	*Nov.*	21
Weems, George T.	*May*	7
Wilson, Major Harold L.	*June*	40
Oil system, closed-circuit, for turbojet and turboprop aircraft engines	*June*	16
O'Neill, James E. An Experimental Investigation of Supersonic Lattice Flow	*Jan.*	28
Packaging of air-borne electronic equipment	*May*	29
Performance—		
A Method of Calculating the Landing Flare Path of an Airplane, Robert D. Fusfeld	*Feb.*	25
Operational Aspects of Turbo-Jet Transports, R. Dixon Speas	*Nov.*	48
Variation in Airplane Range with Wind Velocity, Robert E. Hage	*July*	18
Pilotless aircraft research	*Oct.*	24
Pressurization, cabin, general aspects of	*July*	14
Range, airplane, variation in, with wind velocity	*July*	18
Rea, James B. Analysis of Systems for Automatic Control of Aircraft	*Nov.*	39
Research, aeronautical, in England with particular reference to stability and control, some observations on	*Dec.*	45
Research and development, military	*Apr.*	49
Rentzel, The Hon. Delos W. Air Traffic Control	*May*	18
Robson, Captain R. C. All-Weather Flying	*May*	44
Rottmayer, Earl. Interaction Curves for the Critical Loads on Continuous Beam-Columns	*Mar.*	40
Rummel, R. W. General Aspects of Cabin Pressurization	*July*	14
———. Review of Papers on Air Transport	*Dec.*	40
Safety research, flight	*Apr.*	31
Safety, transport, some special aspects of air	*July*	23
Schutz, Dr. Harald. Air-Borne Antenna Problems	*May*	32
Schwartz, Martin D., and Donald L. Wrisley. Investigation of Flight-Flutter Testing Techniques	*Aug.*	24
Schweitzer, P. H. Closed-Circuit Oil System for Turbojet and Turboprop Aircraft Engines	*June*	16
Seaplanes and Flying Boats—		
Hydrodynamic Notes on the Third International Aeronautical Conference, Ernest G. Stout	*Dec.*	49
Shrader, Welman A. Electronics for Aircraft Illustrated	*May*	12
———. Impressions of the Third Anglo-American Aeronautical Conference	*Dec.*	24

	Month	Page
———. Ocean Test Tube, International Nickel Company's Laboratories, Kure Beach and Wrightsville Beach, N.C.	*Jan.*	24
———. Pilotless Aircraft Research at N.A.C.A.'s Pilotless Aircraft Research Station, Wallops Island, Va.	*Oct.*	24
SHULER, WILLIAM T. Fatigue Problems in Transport Aircraft	*June*	20
SIKORSKY, IGOR I. Helicopters—Present and Future	*Feb.*	37
SMITH, MAURICE H. Service for Contractors	*Apr.*	12
SPEAS, R. DIXON. Operational Aspects of Turbo-Jet Transports	*Nov.*	48
Standardizing electronic equipment for aircraft, problems of	*May*	24
STEVENS, FREDERICK, AND K. MARTIN STEVENSON. A Design Method for Automatic Longitudinal Control Systems	*Jan.*	18
STEVENSON, K. MARTIN, AND FREDERICK STEVENS. A Design Method for Automatic Longitudinal Control Systems	*Jan.*	18
STOUT, ERNEST G. Hydrodynamic Notes on the Third International Aeronautical Conference	*Dec.*	49
Stress Analysis and Structures—		
Fatigue Problems in Transport Aircraft, William T. Shuler	*June*	20
Interaction Curves for the Critical Loads on Continuous Beam-Columns, Earl Rottmayer	*Mar.*	40
A Review of Papers on Structures and Materials, Nicholas J. Hoff	*Dec.*	42
Summaries of Technical Papers—		
I.A.S. Previews... *Jan.*, 43; *Feb.*, 39; *Apr.*, 63; *May*, 57; *June*, 35; *Aug.*, 37; *Sept.*, 35; *Oct.*, 35; *Nov.*, 63;	*Dec.*	53
Supersonic lattice flow, an experimental investigation of	*Jan.*	28
TAYLOR, PHILIP B. Military Research and Development	*Apr.*	49
THOMPSON, E. S., AND N. BURGESS. Comparisons of British and American Gas-Turbine Practice	*Dec.*	47
THOREN, R. L., AND W. L. HOWLAND. Autopilot Flight Tests on the Constellation	*Nov.*	31
TOWLE, H. C., AND F. V. H. JUDD. Ejectors for Cooling a Turbojet Installation	*Sept.*	20
Transport aircraft, fatigue problems in	*June*	20
Transport aircraft, practical aspects of turbojets in.	*Mar.*	32
Transport, jet, operation at 40,000 ft., some meteorological problems indicated for	*Apr.*	52
Transports, turbo-jet operational aspects of	*Nov.*	48
Upper atmosphere—its exploration and exploitation	*Feb.*	20
VANDERLIP, EDWARD G., DONALD N. MEYERS, AND P. HALPERT. A Tested Solution of the Problem of Helicopter Stability and Automatic Control	*July*	27
WEBB, THE HON. JAMES E. Honors Night Dinner Address	*Mar.*	30
WHITE, EDWIN LEE. Frequency Allocation for Aviation Electronics	*May*	38
Wind Tunnels—		
Colorado University's Steam-Jet-Powered Supersonic Wind Tunnel	*Mar.*	38
WRISLEY, DONALD L., AND MARTIN D. SCHWARTZ. Investigation of Flight-Flutter Testing Techniques	*Aug.*	24
WYATT, DE MARQUIS D. Aerodynamic Forces Associated with Inlets of Turbojet Installations.	*Oct.*	20
ZAND, DR. STEPHEN J. Nineteenth Annual Meeting—Impressions and Comments	*Apr.*	35

Index to A

A

★Aerojet Engineering Corporation 131
Aeronautical Engineering Review 131
Aeroproducts Division, General Motors Corporation 83
★Aeroquip Corporation 14
Air Reduction Company, Inc., Ohio Chemical & Surgical Equipment Company Division 77
★Airborne Accessories Corporation 54
Allied Products Corporation 10
Allison Division, General Motors Corporation 51
Aluminum Company of America 13, 110
American Phenolic Corporation 116
Arkwright Finishing Company 98
Arma Corporation, American Bosch Corporation Subsidiary 91
Astron Corporation 124

B

B. H. Aircraft Company Inc. 72
Bauer & Black Division, The Kendall Company 16
Bell Aircraft Corporation 132, 136
★Bendix Aviation Corporation
★Eclipse-Pioneer Division 95
★Scintilla Magneto Division ..... Inside Back Cover, 99
★BG Corporation, The 9
Birtcher Corporation, The 77
Boeing Airplane Company 135
★Breeze Corporations, Inc. 11
Brush Development Company, The 107
Bunhill Publications Limited 110

C

Cal-Aero Technical Institute 110
★Cannon Electric Company 126
★Clifford Manufacturing Company Division, Standard-Thomson Corporation 125
Consolidated Vultee Aircraft Corporation 134
Ralph C. Coxhead Corporation 110

D

Douglas Aircraft Company, Inc. 78, 79
Dow Chemical Company, The, Magnesium Department 101
Dow Corning Corporation 81

E

★Eclipse-Pioneer Division, Bendix Aviation Corporation 95
★Electrical Engineering & Manufacturing Corporation 15
Electronic Engineering Associates, Ltd. 122
Extruders Inc., Aircraft Products Division 112

F

★Fairchild Engine and Airplane Corporation
★Fairchild Aircraft Division 93
Guided Missiles Division 127
Foote Bros. Gear and Machine Corporation 129

G

General Electric Company, Aircraft Gas Turbine Department 130
General Motors Corporation
Aeroproducts Division 83
Allison Division 51
Harrison Radiator Division 71
General Radio Company 4
B. F. Goodrich Chemical Company 75
B. F. Goodrich Company, The, Aeronautical Division 84
Goodyear Tire & Rubber Company, Aviation Products Division 1
Guided Missiles Division, Fairchild Engine and Airplane Corporation 127

H

Hagan Corporation 63
Harrison Radiator Division, General Motors Corporation 71

I

Imperial Pencil Tracing Cloth, Keuffel & Esser Company 122
Indiana Gear Works 86
★Industrial Sound Control, Inc. 119
International Nickel Company, Inc., The 17, 89

J

★Jack & Heintz, Inc. 105
★Johns-Manville 97

K

Kendall Company, The, Bauer & Black Division ... 16
Keuffel & Esser Company 6, 7
Imperial Pencil Tracing Cloth 122
Walter Kidde & Company, Inc. 52
Kollsman Instrument Corporation 65

L

Lamb Electric Company, The 60
Lear, Incorporated, Romec Division 127
Libbey-Owens-Ford Glass Company, Fiber-Glass Division 68, 69
Linear, Inc. 117
Lockheed Aircraft Corporation 136
Lord Manufacturing Company 54

M

Marman Products Company Inc. 120
Glenn L. Martin Company, The 12
The Maxim Silencer Company 73
McDonnell Aircraft Corporation 132

Advertisers

★Meletron Corporation 123
Minneapolis-Honeywell Regulator Company, Aeronautical Division ..... Back Cover
Minnesota Mining and Manufacturing Company, Adhesives and Coatings Division 18

N

North American Aviation, Inc. 130, 136
Northrop Aircraft, Inc. 108, 109, 132

O

Oakite Products, Inc. 112
Ohio Chemical & Surgical Equipment Company Division, Air Reduction Company, Inc. 77

P

★Pacific Scientific Company 55
Pittsburgh Plate Glass Company, Industrial Paint Division 98

R

Reaction Motors, Inc. 76
Republic Steel Corporation Steel & Tubes Division 8
Resistoflex Corporation ..... Inside Front Cover
Rigidized Metals Corporation 80
★Rohr Aircraft Corporation 114
Romec Division, Lear, Incorporated 127
Ryan Aeronautical Company 67

S

Sandia Corporation 134
★Scintilla Magneto Division, Bendix Aviation Corporation ..... Inside Back Cover, 99
Shafer Bearing Corporation 118
Skinner Electric Valve Division, The Skinner Chuck Company 112
Standard Products Company, The 61
★Standard-Thomson Corporation 64
★Clifford Manufacturing Company Division 125
P. A. Sturtevant Company 112
Surface Combustion Corporation, Aircraft-Automotive Division 56, 57

U

United States Aviation Underwriters Incorporated .. 127
University of Michigan 132

V

Varflex Corporation 5
★Vickers Incorporated, Division of the Sperry Corporation 144

W

Waterman Products Company, Inc. 59
★Western Gear Works 103
Westinghouse Electric Corporation 121
Weston Electrical Instrument Corporation 66
★Wittek Manufacturing Company 59
Wyman-Gordon Company 2

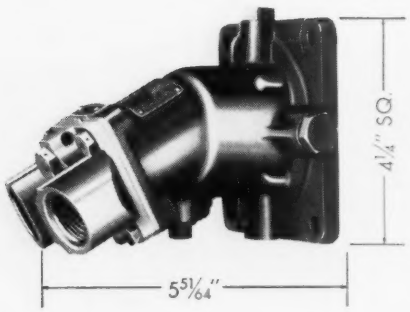
★ *Specifications and further information on the aircraft products of these companies will be found in the* 1951 AERONAUTICAL ENGINEERING CATALOG

The only publication of its kind devoted exclusively to the aircraft industry, this CATALOG serves as a valuable buyers' and reference guide to sources and specifications on aircraft materials, parts, and accessories. It is distributed annually to Chief Engineers, Designers, Production Heads, and Purchasing Departments of all leading Aircraft, Aircraft Engine, Instrument, Accessory, and Aircraft Parts Manufacturers; Air Transport Companies; Army, Navy, and Governmental Agencies; Research Organizations; Engineering Libraries; etc.

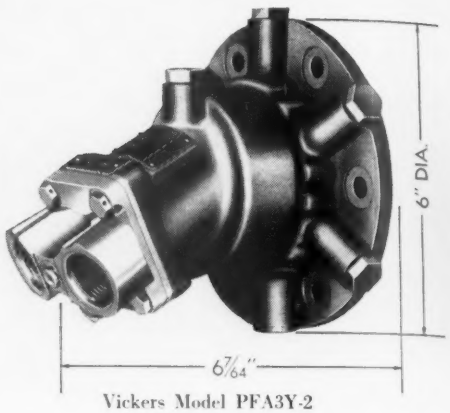
Published Annually by

INSTITUTE OF THE AERONAUTICAL SCIENCES

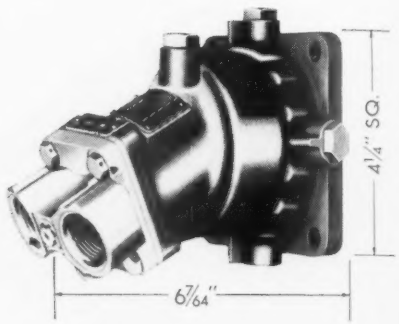
2 East 64th Street New York 21, N.Y.



Vickers Model PFA2
(AN-4148 & AN-6251-1) 1.9 hp/lb



Vickers Model PFA3Y-2
(AN-4149) 1.5 hp/lb



Vickers Model PFA3Z-2
(AN-6252-1) 1.7 hp/lb

These VICKERS Piston Type Pumps

CONSTANT DISPLACEMENT—3,000 PSI

have AN approval

The Vickers Constant Displacement Piston Type Hydraulic Pumps shown above have AN approval. They meet the 2 and 3 gallon size requirements of AN-P-11b. The use of these items may help speed up your aircraft production.

Reliability and long service life are important features of these pumps. Volumetric (96%) and over-all (92%) efficiencies are very high. Small size and extremely high horsepower to weight ratio at rated loads and speeds are as noted. As displacement is fixed, the delivery is constant at any given speed, and varies directly with the speed. The design includes a metered valve plate feature which results in negligible system pressure pulsations.

We shall welcome an opportunity to supply more detailed information.

VICKERS Incorporated

DIVISION OF THE SPERRY CORPORATION

1414 OAKMAN BLVD. • DETROIT 32, MICH.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

4603

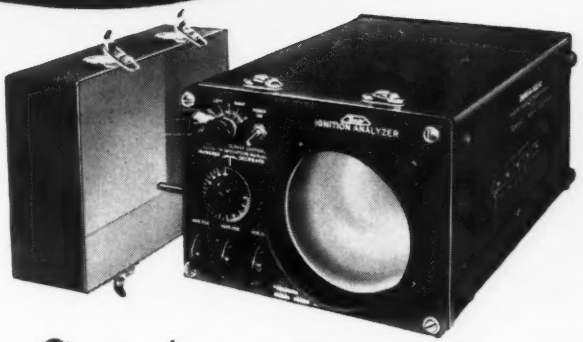
The BENDIX IGNITION ANALYZER Checks More Plugs Faster!

Result: TIME-SAVING

KEEPS PLANES ON SCHEDULE BY ELIMINATING HIT AND MISS TROUBLE SHOOTING

Even before the wheels touch the runway, the ignition fault has been pin-pointed and a maintenance crew stands by to make a fast repair. Minutes later the ship departs *on schedule*. The fast, certain repair job was possible because the trouble shooting was done in flight, by the operator of a Bendix Ignition Analyzer. While making a routine check of several plugs the scope reading showed a trouble pattern. The operator quickly analyzed the location and seriousness of the trouble and the word was radioed ahead. Meanwhile, the pilot reduced power of the malfunctioning engine to cool it in flight and ready it for maintenance. Just such a case as this is the reason why one airline has reduced turn-around time by 18% with the Bendix Ignition Analyzer. It can do the same for you and much more besides.

Write us for free literature concerning the Bendix Ignition Analyzer.



Costs Less—Does More

The Bendix Ignition Analyzer is available for either airborne or portable-airborne installations. It can be used with either high or low tension magneto or battery ignition. It is the ignition analyzer that can predict spark plug failure before it occurs . . . make an efficient check of more than one spark plug at a time and do so on a large, easy to read screen . . . yet it costs less than comparable analyzers.

Bendix

SCINTILLA MAGNETO DIVISION OF SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FACTORY BRANCH OFFICES: 117 E. Providencia Avenue, Burbank, California • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan
Brouwer Building, 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

Sir Isaac never dreamed of anything like this!

Back in the 17th century, even Newton couldn't have foreseen the day of automatically controlled flight. Yet the principles he expounded make it possible for this plane to hold so steady in a bank that a precariously perched glass of water isn't even disturbed!

One of those principles – his first law of motion – is the basis for the formula governing gyro behavior. Honeywell engineers, following this lead, designed a vertical gyro second to none, that is the heart of the dependable Honeywell Autopilot – standard equipment on the B-36 and B-50 – that's flying the airplane pictured here. By always knowing which way is up, the gyro vertical, together with other autopilot components, operates the control surfaces to coordinate aircraft turns.

Today Honeywell *specializes* in gyros; is the nation's fastest-growing manufacturer in this important field. Honeywell rate gyros used in the yaw damper control now are installed on six major types of aircraft. Still other Honeywell gyros, some so versatile they measure angular rates as slow as ¼ of a degree a minute and as fast as 45 degrees a second (a 10,800 to 1 range of angular rates), are used in the radar and guided missile programs.

Experiments to improve and find new applications for gyroscopic controls are constantly being made by Honeywell engineers. We are broadening our research in this and other fields of control – because *automatic control* is such an important part of aviation progress. And *automatic control* is Honeywell's business.

Aeronautical Division
MINNEAPOLIS-HONEYWELL • MINNEAPOLIS 8, MINN.

MINNEAPOLIS **Honeywell**

Aeronautical Controls